

# A level Revision Guide – Check list

## Unit 1 PROD1 Materials, Components and Application

### Section A: Materials and Components

At AS level candidates should develop an understanding of the physical and mechanical properties of a broad range of materials and components. They should understand why these are used in specific applications with particular emphasis on the life-cycle of products including manufacture, use and disposal.

Candidates should have a good understanding of the methods by which materials and components can be manipulated to manufacture products. Through study and first-hand experience in practical project work, candidates will also develop knowledge of the health and safety issues relevant to working with materials. Coursework projects may also provide an opportunity for students to learn about the use of computer aided design (CAD) and computer aided manufacture(CAM), and the use of basic quality control measures.

In addition to this, through study and detailed analysis of a wide range of products, candidates should begin to develop knowledge and understanding of the broader issues for the designer such as: environmental sustainability of products and their manufacture, ergonomic and anthropometrics, inclusive design, and consumer safety.

<b>Classifications which determine the market forms of a range of timber, metal, plastics and composite materials</b> A range of materials appropriate to modelling and prototyping			
<b>Natural woods</b> Hardwoods, including beech, oak, ash, mahogany, teak. Softwoods including: Scots pine, spruce, Douglas Fir, and the availability of stock forms, including: rough sawn and P.S.E, 'FSC' marked softwood. Applications for natural woods e.g. furniture, decorative products, jewellery/craft, construction.			
<b>Man-made boards</b> Man-made boards including: plywood, aero ply, flexi-ply, marine ply, chipboard, MDF and hardboard. Applications for man-made boards e.g. furniture, work surfaces and exterior projects			
<b>Laminates and veneers</b> Veneers such as beech, ash, oak, walnut, paper and foil backed Laminates such as 'Formica' (coated printed paper or foil laminates) Applications for veneers and laminates e.g. decorative surfaces, laminate flooring, jewellery furniture			
<b>Ferrous metals</b> Ferrous metals including: mild steel, high carbon steel, cast and wrought iron. Availability of stock forms such as sheet, bar, tube and angle. Applications for ferrous metals such as car body panels, tools, white goods and machine parts.			
<b>Non-Ferrous metals</b> Non-ferrous metals including: aluminium, copper, zinc, gold, silver and titanium Availability of stock forms e.g. sheet, tube, ingot. Applications for non-ferrous metals such as kitchen ware, jewellery, food wrapping, cans and electronics.			
<b>Alloys</b> Ferrous alloys including: stainless steel, high speed steel and die (tool steel). Applications for ferrous alloys e.g. kitchen ware, street furniture, cutting and press tools. Non-ferrous alloys including; bronze, brass, pewter, and duralumin/aluminium alloys. Applications for non-ferrous alloys such as ornaments, valves, boat fittings, sculpture, coins and jewellery.			
<b>Polymers</b> Thermoplastics including: ABS, PET, PMMA (acrylic), Polypropylene, High Impact Polystyrene, Expanded Polystyrene, Low and High Density Polyethylene, Nylon and UPVC Applications for thermoplastics such as mobile communications products, toys, car parts, packaging, kitchen ware, pipes and window frames. Thermosets including: Epoxy resins, Polyester resins, Urea Formaldehyde and Melamine Formaldehyde. Applications for thermosets such as decorative laminates, casting and encapsulation, tableware and electrical fittings.			
<b>Biodegradable' polymers</b> Degradable polymers (Oxo-degradable) Biodegradable polymers ('bio-batch' additive mixed polymers)			
Compostable polymers including: cellulose based polymers such as Biopol, and corn starch based polymers such as Polylactide (PLA). Applications for 'biodegradable polymers' such as carrier bags, plastic bottles and detergent sachets. Absorbable/water soluble polymers including: lactide, glycolide, ('Lactel') and 'Ecofilm'. Medical applications such as slow release medication, bone repair fixings, detergent washing liquid sachets.			
<b>Elastomers</b> Common elastomers such as Thermoplastic Elastomers (TPE), Thermoplastic Rubber (TPR) and Liquid Silicon Rubber (LSR). Applications for elastomers such as car bumpers and trims, and product grips (over mouldings).			
<b>Composites</b> Fibre Reinforced Polymers including: glass (GRP), Carbon Fibre (CFRP) and Kevlar. Applications for FRP such as boat building, sports car manufacture, performance sports equipment and body armour.			

Particle based composites including: concrete and cermets such as tungsten carbide. Applications for concrete such as structural building components, garden ornaments and paving. Applications for cermets such as cutting tools.			
<b>Compliant materials</b> Paper: including layout paper, bleed proof, photo quality cartridge and watercolour Applications such as design drawings, presentations and graphic products. Card including carton board, multi-sheet, laminated, corrugated, metal effects, and mount board. Applications such as model making and packaging. Reflective films and holograms Applications such as reflective/warning patches, jewellery and security holograms. Polymer based sheet and films including: foam board, fluted and translucent polypropylene sheet, acetate, Styrofoam, modelling foam, low density polyethylene sheet, and plastazote foam. Applications such as packaging, point of sale displays, and model making.			
<b>Smart Materials</b> Shape Memory Alloy (SMA), such as 'Nitonol' (Nickel-Titanium alloy). Applications such as flexible spectacles (superelastic wire), heat activated cable connectors, muscle wires, and fire sprinkler control. Thermochromic pigment (Smart colours). Applications such as thermometers, baby feeding products, kettles, steam irons, thermal warning patches, and hi-tech jewellery. Thermochromic sheet. Applications such as thermal warning patches, battery condition indicators and jewellery. Photochromatic pigment. Applications such as sunglasses, anti-flash visors, sun-blocking products and radiation indicators. Phosphorescent pigment. Applications such as emergency exit signs, jewellery and toys Polymorph. Applications such as modelling grip prototypes.			
<b>Modern Materials</b> Metal based, including: coated metals e.g. anodised aluminium sheet, nickel plated steels, polymer coated aluminium, Alu composite- (polythene cored aluminium sheet). Aluminium foam and titanium. Wood based-including: flexible MDF, flexi-ply, aircraft grade plywood, Hexaboard and paper backed veneers.			
<b>Product components</b> Knock Down fittings including: Barrel nut and bolt, corner plates, block connectors and dowels. Common applications e.g. Flat Pack furniture. Fastenings including: wood screws, self tapping, screws and bolts. Common applications such as temporary joining methods.			
<b>Adhesives</b> Common adhesives and uses including: Solvent Cement/Tensol 12 for joining acrylic PVA for wood and papers. Contact Adhesive (Evostik) for mixed materials such as laminate to MDF. Epoxy resin (Araldite) for mixed materials such as metals to woods UV hardening adhesive (Superglue substitute).			

## Section B: Design and Market Influences

Through study and detailed analysis of a wide range of products, candidates should begin to develop knowledge and understanding of the broader issues for the designer such as: environmental sustainability of products and their manufacture, ergonomic and anthropometrics, inclusive design, and consumer safety.

<b>Environmental/Sustainability Issues</b> Selection of materials and manufacturing processes to reduce environmental impact. The 3R's – (Reduce, Reuse, and Recycle) and application to design and manufacture.			
<b>Ergonomics and anthropometrics</b> The application of ergonomics and anthropometrics such as in the use of product shaping, textures, colours, and physical size to promote ease of use			
<b>Inclusive Design</b> How designers meet the needs of all users, including the disabled, in a range of product areas.			
<b>Consumer Safety</b> At AS level, candidates should have an understanding of the main methods designers and manufacturers employ to ensure products are safe to use. They should be able to describe basic safety features in products such as electrical consumer goods, toys. Candidates should be able to describe simple safety tests that they might use on products.			

## Section C: Processes and Manufacture

Candidates should have a good understanding of the methods by which materials and components can be manipulated to manufacture products. Through study and first-hand experience in practical project work, candidates will also develop knowledge of the health and safety issues relevant to working with materials. Coursework projects may also provide an opportunity for students to learn about the use of computer aided design (CAD) and computer aided manufacture (CAM), and the use of basic quality control measures.

<b>Fabrication methods:</b>			
<b>Woods</b> Traditional joining methods including: mortise and tenon, dowel, dovetail and comb. Knock Down Fittings and fastenings.			
<b>Metals</b> Permanent joining methods such as: soldering, brazing, riveting, welding (including oxy-acetylene, MIG and spot) Temporary joining methods such as self-tapping			

screws, machine screws, nut and bolt.			
<b>Plastics</b> Permanent joining methods including plastic welding and bonding with adhesives.			
<b>Forming methods:</b>			
<b>Woods</b> Techniques including steam bending and laminating.			
<b>Metals</b> Techniques including: press forming, cupping and deep drawing, drop forging and wrought iron forging techniques.			
<b>Plastics</b> Techniques including: vacuum forming, thermoforming and line bending.			
<b>Composites</b> 'Lay-up' resin techniques, laminating, casting including: concrete and resin.			
<b>Redistribution methods</b> Casting (including: sand, die and investment). Extrusion techniques to manufacture bar and profiles.			
<b>Metals</b> Casting, spinning and pressing			
<b>Cermets</b> Sintering			
<b>Polymers</b> Moulding processes including: injection moulding, blow moulding, rotational moulding and compression moulding.			
<b>Wasting processes</b> Common wasting processes including: drilling, turning and milling. Profile or shape cutting using routers, millers, flame cutting, and laser cutting. Piercing and blanking processes.			
<b>CAM Processing</b> For example: CNC laser cutters for 2D cutting and engraving sheet materials. CNC routers for 3D machining of block and sheet materials. CNC plotter cutters for 2D printing and cutting of vinyl. Use of 3D printers or stereo lithographic modellers to prototype designs.			
<b>Finishing materials and processes:</b>			
<b>Woods</b> Common forms of wood preservatives including: water based, exterior, stains, yacht varnish and polyurethane varnish. Finishes to enhance aesthetics e.g. gloss paints, stains and colour wash and wax finishes. Methods of application including: spray, dip and pressure treating. Laminate coverings for sheet materials.			
<b>Metals</b> Primers including zinc and red oxide primers. Paints including acrylic and cellulose based Method of application including: brush, spray, dip and powder coating. Plating including: chrome, silver and tin plated. Galvanizing. Dip coating with polymers. Brushed/polished stainless steel.			
<b>Polymers</b> Pigments and stabilisers. Applied finishes including: acrylic paints and chrome effects			
<b>Health and Safety</b> COSHH-Control of Substances Hazardous to Health, Health and safety precautions associated with common school workshop processes. General health and safety measures carried out to protect employees in manufacturing industries. Risk assessments for hand and commercial processing.			
<b>Quality Control</b> Inspection of stock materials for defects. Use of measuring devices including callipers, micrometers and go/ no go gauges. Use of drilling jigs and templates. Use of mitre saws and mitre blocks. Use of welding jigs or fixtures.			