

1. Materials; Ferrous Metals

These Metals Contain IRON (Fe).

1	Cast Iron	Machine Bases, Metalworking Vices
2	Tool Steel (Die Steels)	Screwdrivers, Hammers, Saws
3	Stainless Steel	Sinks, Rules, Cutlery
4	High Speed Steel	Drill Bits, Lathe Tools
5	Low Carbon Steel	Low hardness and cost. High ductility, toughness, car body panels.
6	Medium Carbon Steel	Medium strength, ductility and toughness. Structural applications, nuts & bolts

Students should know and understand the classifications of the following materials and be able to name examples that belong to each category: **METALS**

1. Materials; Alloys

A mixture of two or more metals.

15	Brass	Plumbing Accessories, musical instruments
16	Bronze	Boat Propellers, statues
17	Pewter	Traditional dining implements, jewellery.
18	Duralumin	Aircraft body panels

1. Materials; Non-ferrous Metals

Metals which **do not** contain IRON.

7	Copper	Plumbing & Electrical Components
8	Aluminium	Cooking Foil, Sauce Pans, Ladders
9	Zinc	Coatings On Steel Products
10	Tin	Coating On Food Cans
11	Lead	Weather Proofing For Roofs
12	Titanium	Jewellery, Surgical Implants.
13	Gold	Jewellery, Electronic components
14	Silver	Jewellery, tableware, mirrors

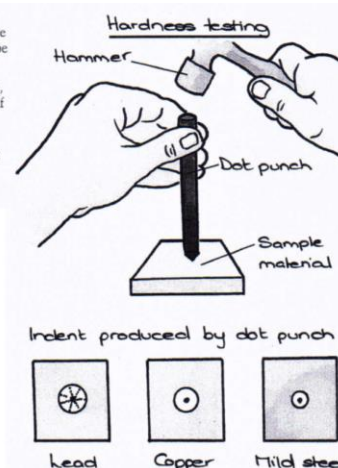
Tensile strength

An indication of tensile strength is the amount of energy required to bend a material. A comparison of tensile strength can be made by clamping sample materials of similar length in the jaws of a vice, and applying the same load to them. In this case, it is the resistance of the material to the load being applied that is being tested.

Hardness

Hardness can be tested in a number of ways – two are given here. (Both of the following methods can also be used to compare two materials.)

- 1 A file can be run over the material. If the file cuts, then the material is soft, i.e. softer than the file; if it does not cut, then it is harder than the file.
- 2 A dot punch is used to create an indent in the material. It is most important that when comparing materials, the amount of effort used in striking the dot punch with the hammer is the same for all sample pieces.

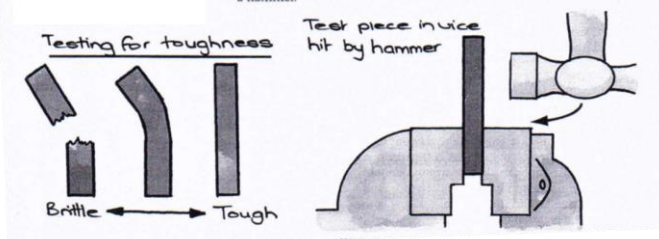


Material Properties

1	Malleability	The ability to be pressed, spread and hammered into shape.
2	Toughness	Withstanding force without breaking permanently.
3	Hardness	Resistance to scratching, cutting, denting and wear.
4	Resistance to corrosion	How well a metal can withstand damage caused by oxidization or other chemical reactions – rust
5	Thermal conductivity	A measure of its ability to conduct heat
6	Electrical conductivity	How strongly the material resists or conducts electric current
7	Strength	How easily a material will bend or distort.
8	Tensile strength	Withstand a force when stretched.
9	Compressive strength	Withstand force when being crushed.

Toughness

Toughness is a material's ability to absorb mechanical shock from, for example, a hammer blow. A comparison of materials' toughness can be made by clamping samples of materials in a vice, then striking them with a hammer.



2 Materials; Thermoplastics

Can be remoulded numerous times with the application of heat..

1	Acrylonitrile-butadiene-styrene (ABS)	Appliance Casings – Mobile phone, electronic gadgets.
2	Low Density Polyethylene (LDPE)	Pipes, Buckets, Toys
3	High Density Polyethylene (HDPE)	Some plastic bottles, Pipes
4	High Impact Polystyrene (HIPS)	Vacuum Forming, Electronics Casings
5	Polyvinyl Chloride (PVC)	Water Pipes, Chemical Tanks
6	Nylon	Curtain Rails, Hinges, Clothes
7	Polymethylmethacrylate (PMMA) Acrylic	Safety Goggles, Bullet Proof Windows.
8	Polypropylene (PP)	Medical Equipment, Food Containers.
9	Polyethylene Terephthalate (PET)	Single use Disposable bottles, food packaging.

Students should know and understand the classifications of the following materials and be able to name examples that belong to each category: **POLYMERS**

2 Materials; Thermoset Plastics

Polymers which **cannot** be remoulded once set in shape.

10	Polyester Resin (PR)	Used in GRP – Car/ Boat bodies
11	Urea-formaldehyde	Electrical fittings, Door Handles.
12	Epoxy Resin	Glue, Casings, Coatings.
13	Melamine-formaldehyde	Heat resistant kitchen worktops

2. Materials; Biodegradable polymers

Are designed to degrade upon disposal by the action of living organisms (or oxygen, moisture, UV light). Polymers such as starch, cellulose, and lactic acid.

1	Polyactide (PLA)	Packaging.
2	Biopol (Bio-batch Additive)	PHB (polyhydroxybutyrate) – plasters, bottles, medical inserts, nappies.
3	Corn Starch Polymers	Disposable plates, cups, and packaging material.
4	Potatopak	Disposable plates and trays from waste starch.
5	Polyhydroxyalkanoate (PHA)	Biomedical applications; stents, and drug delivery devices. Packaging, food packaging, and disposable tableware
6	Lactide & Glycolide	Biomedical grafts and prosthetic devices. (Lactel and ecofilm) – Water Soluble:

2. Materials; Elastomers

Elastomer is another name for “rubber”. Some polymers which are elastomers include polyurethanes. What makes elastomers special is that they can be stretched (or squashed) to many times their original length, and can bounce back into their original shape without permanent deformation. used to enhance products, for example in producing grips for improved ergonomics.

1	Natural Rubber	Engineering applications; like anti-vibration mounts, drive couplings, springs, bearings, rubber bands, and adhesives.
2	Polybutadiene	High resistance to wear and is used especially in the manufacture of tyres.
3	Neoprene	Laptop sleeves, orthopedic braces (wrist, knee), wet suits.
4	Silicone	Flexibility and exceptionally high heat resistance, suitable for applications in the electrical, electronic, automotive, aerospace, and construction industries. Adhesives and sealant.
5	Thermoplastic Elastomer (TPE)	Good tear & abrasion resistance High impact strength Used in plugs, seals, grips and handles .



Softwoods – come from conifer trees, or cone-bearing trees, they have needle-shaped and their grain is not as tightly bound together as hardwood.		
7	Pine	Furniture, window frames, panelling, floors, and roofing
8	Spruce	Structural timber such as joists & roof truss timbers
9	Douglas Fir	Flooring, furniture, cabinets
10	Redwood	Construction lumber, beams, posts, decking, exterior furniture
11	Cedar	Outdoor projects like patio chairs & tables, birdhouses, and feeders, cladding, boats.
12	Larch	Flooring , Decking, cladding, furniture, beams
Manufactured boards – Timber sheets produced by gluing wood layers or wood fibres together. They are often made from waste wood. Been developed mainly for industrial production as they can be made in very large sheets of consistent quality.		
13	Plywood	Furniture, flooring, roofing
14	Marine Plywood	Exterior products, boats
15	Aeroply	Ideal for curves, irregular shapes and forms.
16	Flexible Plywood	Non-structural applications where curvature and creativity are essential.
17	Chipboard	Flooring, budget furniture and work surfaces
18	Medium Density Fibreboard (MDF)	Kitchen cabinets and shelving units, mouldings, budget doors & frames.
19	Melamine Formaldehyde Laminates.	Used for walls, cabinets and counters, and to make decorative laminated panels.

3. Materials; Woods		
Hardwoods – are usually have broad leaves they come from deciduous or broad-leaved trees. And are deciduous.		
1	Oak	Indoor furniture, building construction.
2	Ash	Furniture, doors, tool handles, baseball bats, hockey sticks, oars.
3	Mahogany	Musical instruments, boats, furniture.
4	Teak	Interior & exterior furniture.
5	Birch	Toys, toothpicks, paper pulp and high-end furniture.
6	Beech	Musical instruments, kitchen utensils.

4. Materials; Papers And Boards		
1	Layout Paper	Sketch pads
2	Cartridge Paper	High quality type of heavy paper used for illustration, drawing, printing.
3	Tracing Paper	Copying images . low opacity, allowing light to pass through.
4	Bleed Proof Paper	Bleed proof paper is similar to cartridge paper but it is particularly good at separating water based paints and pens so they don't run into adjacent areas. Used in for important presentations where quality is needed.Marker rendering
5	Treated Paper	This makes printed material more shiny and bright, which is why it is typically used for brochures, glossy photos, booklets,photographic printing

4. Materials; Papers And Boards		
6	Watercolour Paper	Watercolor paper can be made of wood pulp exclusively, or mixed with cotton fibres. Ideal for using watercolours on.
7	Corrugated Card	Corrugated fiberboard is a material consisting of a fluted corrugated sheet and one or two flat linerboards. Packaging
8	Bleached Card	White due to the bleaching process it receives, strong and can be easily printed onto, often used on book covers and packaging. Greeting cards and high quality packaging
9	Mount Board	Is a stiff board composed of lightweight foam sandwiched between two layers of paper; modelling
10	Duplex Card	Two layers of card bonded together Stiff, lightweight and printable for packaging; food packaging.
11	Foil Backed And Laminated Card	Foil lined board consists of white card laminated with an aluminium foil surface.; Drinks packaging.
12	Metal Effect Card	Metallic paper and card can be used in a number of applications. For example, add an eye-catching visual element to menus, stationery, packaging, cards .
13	Moulded Paper Pulp	Is a packaging material, typically made from recycled paperboard and/or newsprint. It is used for protective packaging or for food service trays and beverage carriers.; Eco-friendly packaging

5. Materials; New Materials

A new ,modern material is a material that has been engineered to have improved properties.

1	Polymorph	It is a thermoplastic, it is possible to mould polymorph around inserts or into components that would otherwise be extremely difficult to achieve. Examples include orthopaedic splints, ergonomic handles, moulds for vacuum forming, trainer/shoe components and sports protective clothing.
2	High Density Modelling Foam	Used for packaging or as a mould for casting jewellery.
3	Precious Metal Clay (PMC)	Very small particles of metal such as silver, gold, bronze, or copper mixed with an organic binder and water for use in making jewelry, beads and small sculptures.
4	Kevlar	Bicycle tyres and racing sails to bulletproof vests, because of its high tensile strength-to-weight ratio
5	Nano-technology	Sunscreen, cosmetics, food packaging, and clothing

3. Materials; Wood – Extension

1	Rough Sawn	Wood is cut to a basic size on a circular saw. The edges and sides are not smooth.
2	Planed Square Edge (PSE)	Planed square edge means you have one edge planed straight and can measure from there.
3	Planed All Round (PAR)	Means that all four faces along the length are planed ready for use.
4	Mouldings	A shaped strip of wood or other material fitted as a decorative architectural feature

6. Materials; Smart Materials

Smart Materials – materials which have properties that can be significantly changed in a **controlled** fashion by external stimuli, such as heat, moisture, electric or magnetic fields, light.

1	Shape-memory Alloys (Nitinol)	Dental Braces, surgical implants, fire prevention.
2	Thermochromic Materials	Thermometers for rooms, refrigerators, aquariums, and medical use.
3	Photochromic Pigment	Sun glasses
4	Electroluminescent Wire	Shop displays, decoration
5	Piezo Electric Material.	Used as sensors / triggers.
6	Phosphorescent Pigment	Adsorbs light in daylight and slowly emits it in the dark. Emergency signs / clock dials.

4. Materials; Composites

A material made from **two or more** different materials that, when combined, are stronger than those individual materials by themselves.

1	Glass Reinforced Plastic (GRP)	Car / boat bodies, bike frames
2	Carbon Fibre Reinforced Plastic (CFRP)	Bicycle frames, sports equipment
3	Concrete	Constructional applications
4	Tungsten Carbide	Cutting tool tips
5	Aluminium Composite Board	Flat panels consisting of two thin coil-coated aluminium sheets bonded to a non-aluminium core. Displays, cladding.
6	Fibre Cement	Made up of sand, cement and cellulose fibres . Used for roofing, cladding, water protection (wet rooms)
7	Engineered Wood, Eg Glulam	Multiple layers of solid wood bonded together. Laminated beams or other structural use.