D&T Revision:
Material Categories

Papers and Boards
Natural and Manufactured Timbers
Metals and Alloys
Polymers
Textiles

Manufactured Boards

Man Made Sheet Based Materials

MDF





MDF boards are produced by tiny particles of timber glued together and then compressed with a resin adhesive.



MDF can be easily damaged by moisture.



Veneers work very well on MDF.



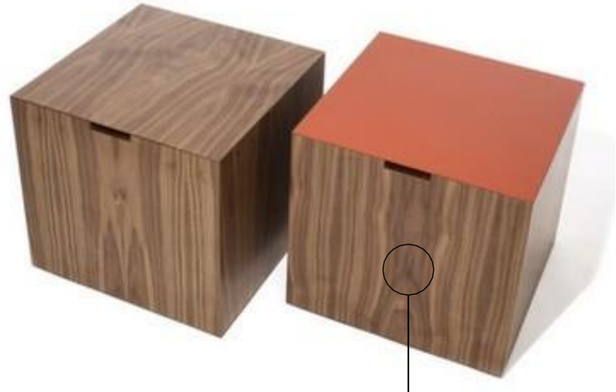
When cut MDF produces a lot of dust which is the subject of some safety concerns. A dust mask should be worn.



MDF does not contain knots or rings, making it more uniform than natural woods. MDF boards are consistent in strength and size.

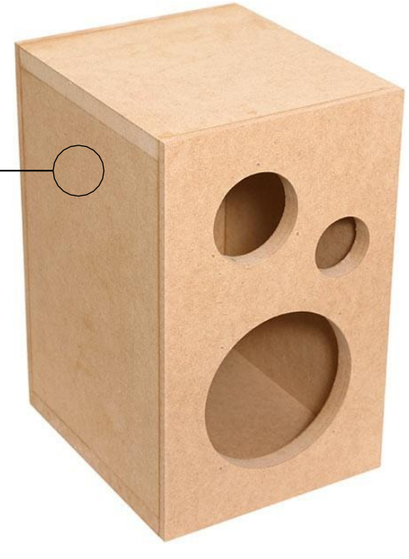
MDF takes paint well and is easy to finish. MDF should be sealed or it may warp or expand.





Veneered MDF provides many of the advantages of MDF with a decorative wood veneer surface layer.

MDF is sometimes used in speaker enclosures, due to its higher weight and rigidity over chipboard.



Man Made Sheet Based Materials

Chipboard





Chipboard is used when appearance and strength are less important than cost.



Chipboard is manufactured by mixing wood particles or flakes together with a resin and forming the mixture into a large sheet.



Chipboard is very prone to expansion and discoloration due to moisture. Therefore, it is rarely used outdoors or places that have high levels of moisture



Chipboard can be made more attractive by the use of wood veneers onto surfaces that will be visible.

Large companies such as IKEA provide furniture at a low price,They do this by using the least expensive materials possible. In almost all cases this means veneered chipboard or MDF or similar.





Philippe Starck's Jim Nature Portable Television of 1994. The design proves that a humble, even banal material, traditionally hidden under veneer, can have a potent, appealing aesthetic impact.

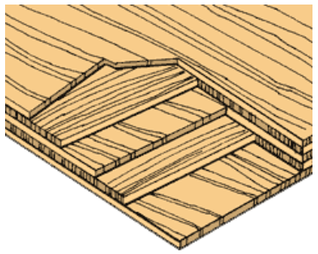
Man Made Sheet Based Materials

Plywood





Plywood uses laminated veneers to produce large sheets of stable material with a natural wood finish.



Layers of hardwood veneer are bonded together with the grain direction in each layer laid at 90 degrees to the previous layer.



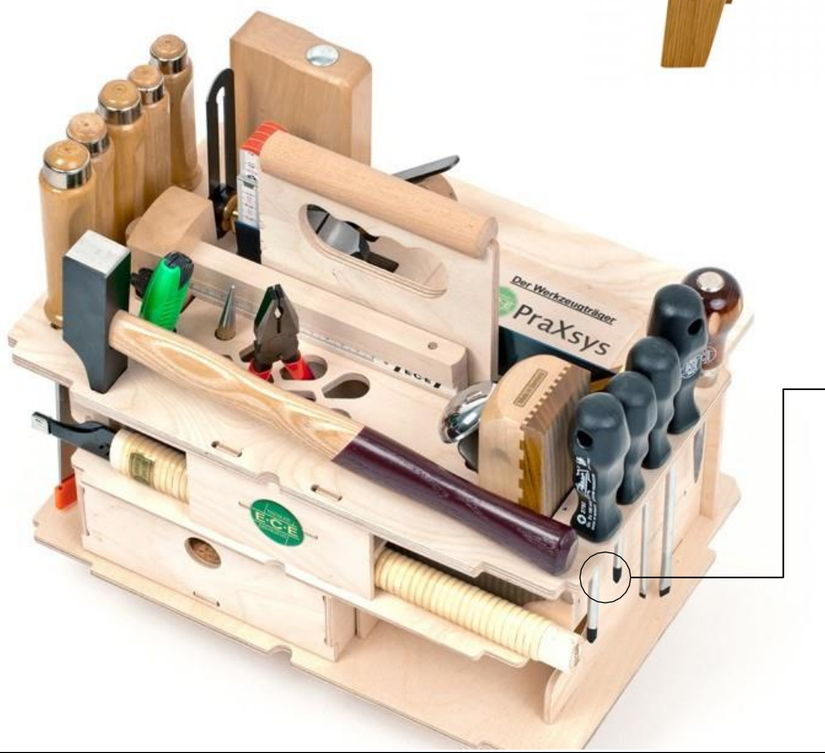
Plywood can be made up of a number of layers resulting in a variety of thicknesses . There is always an odd number of layers.



Interior and exterior versions of plywood are available.

Such as in the manufacture of the1946 Eames designed LCW Chair, plywood can be moulded to produce curved shapes.





Tool carrying case made with CNC milled plywood sections.

Man Made Sheet Based Materials



Blockboard

From a manufacturers point of view, an advantage of Blockboard is that it is easier to work with, since it can take nails and screws. Better than other manufactured boards



Blockboard consists of strips of softwood glued side by side and then sandwiched by sheets of veneer.

The Blockboard core is made from solid blocks of softwood, because it is cheaper and lighter than denser hardwood.





An advantage of being light-weight is that Blockboard can be more easily moved.The most common application of this is doors that we use inside our homes. Doors are very often made from Blockboard.

Man Made Sheet Based Materials



Sterling board



Sterling board is formed by taking shredded or flaked timber particles, adding water-resistant resins and then compressing them into layers.



Sterling board is a material with high mechanical properties that make it particularly suitable for load-bearing applications in construction.



Stirling board can be manufactured with tongues and grooves for fitting to flat roof joists.



Sterling board is used where the appearance of the surface is unimportant, however it has been used creatively and for aesthetic appeal in art and design projects.







Sterling board is used in floors, exterior walls and as roofing material for some homes and in commercial applications. Most of the time, panels are used on roofs and as exterior walls.Thicker panels are used in flooring applications to carry heavier weight loads.

Polymers

Thermoset Polymers

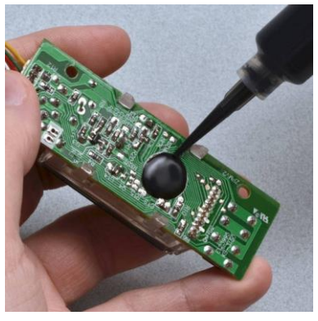
Epoxy Resin



Epoxy is also a common name for a type of strong adhesive used for sticking things together and covering surfaces,



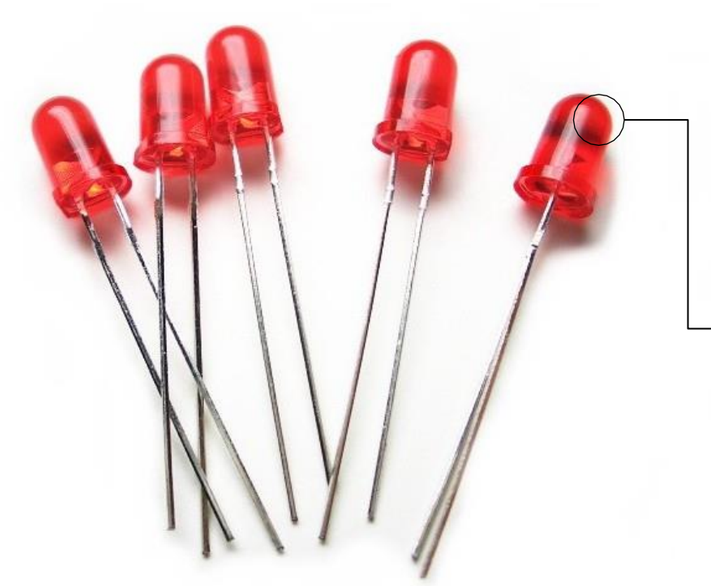
Epoxy Resin comes typically as two resins that need to be mixed together before use.



Epoxy Resin is a good electrical insulator.



Epoxy's can resist chemicals well. It can be found sold in boat shops as repair resins for marine applications.



Casting Epoxy Resin is ideal for making jewellery/beads and other applications requiring a rigid finish. LED's are cast using Epoxy Resin.

The interior of a pocket calculator.The dark lump of epoxy in the centre covers the processor chip.



Thermoset Polymers

Melamine Formaldehyde



Melamine Formaldehyde is one of the oldest commercially used plastics. It is relatively expensive.



Mainly used for plastic tableware, no other thermoset plastic comes close to offering the right characteristics.



As with all thermoset plastics, Melamine Formaldehyde cannot be re-melted and remoulded.



It is available as a compound or resin and so can be injection moulded, compression moulded or extruded.

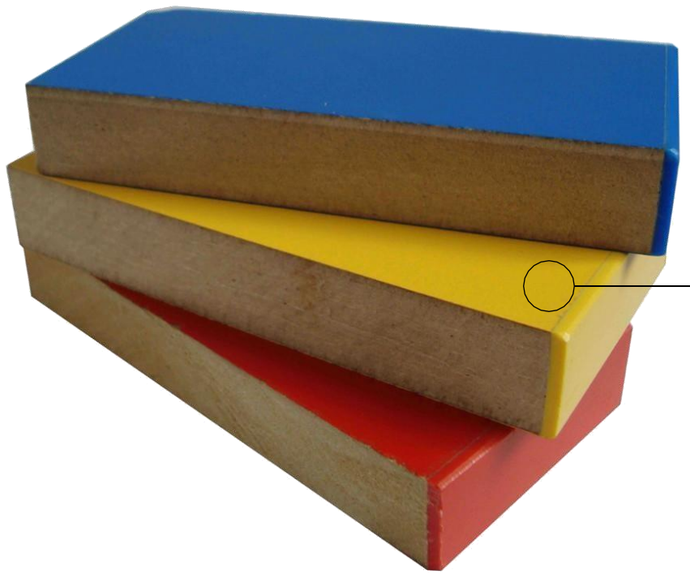


Melamine Formaldehyde has a excellent surface finish and takes colour well.

Melamine Formaldehydes heat resistance makes it perfect for plastic laminates for kitchen surfaces.

Melamine Formaldehyde is non-toxic and imparts absolutely no smell or taste onto food. It feels hard, rigid and unbreakable.

The hard and shiny non-porous finish makes it a popular alternative to ceramics.



Thermoset Polymers

Urea Formaldehyde



Rigid, hard and with good strength are the properties of Urea Formaldehyde.



Urea Formaldehyde can be moulded in many different colours.



One of its key features is it is warm to the touch.



As with all thermoset plastics, Urea Formaldehyde cannot be re-melted and remoulded.



Urea Formaldehydes excellent electrical insulation properties make it the material of choice for most electrical fittings.

Urea Formaldehyde is usually compression moulded

Properties include high tensile strength, flexibility, low water absorption, stain resistance and high heat distortion temperatures. The perfect material for this toilet seat.



Thermoplastic Polymers

ABS (Acrylonitile Butadiene Styrene)



Properties include toughness, hardness and rigidity.



ABS is a popular choice for designers as it is so versatile.



It is low-cost, easy to process and recyclable.



ABS can be flammable when exposed to high temperatures and it has poor resistance to UV light..

ABS is rigid, tough, colourful and shiny and its use in Lego shows how it can be almost unbreakable for the millions of people who play with it.





Scratch resistant with excellent stiffness and dimensional stability ABS is used in a wide range of applications.

Thermoplastic Polymers

Cellulose Acetate



Cellulose Acetate is an attractive plastic that feels warm to the touch.



It is tough and rigid, lightweight, can be transparent and non-flammable.



Cellulose acetate is used as a film base in photography.



Cellulose Acetate is produced using wood pulp, which means less oil is used, making it a more sustainable material.



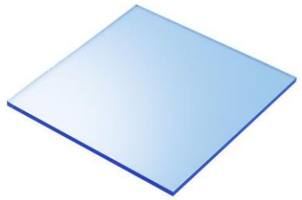
Because of Cellulose Acetate's warm and friendly properties it is used in all sorts of 'close to skin' applications.



Cellulose Acetate can be easily polished

Thermoplastic Polymers

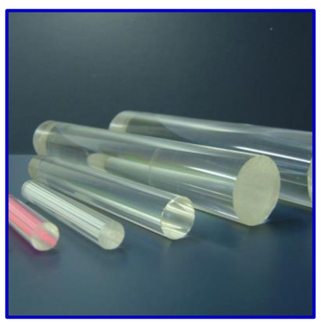
Acrylic



It is a very popular sheet material sold under the name Perspex®.



Acrylic can come in a range of solid, or translucent colours as well as being transparent.



It is a versatile plastic and is widely available in sheet, tubes or rods.



Acrylic is brittle and not very hard wearing or resistant to solvents.

Acrylic can be made to look like glass and create some imaginative transparent products that look high quality and value.





Excellent clarity, and resistance to weathering make acrylic an excellent choice for car tail lights such as these.

Thermoplastic Polymers

Nylon



Nylon is resistant to wear with a low coefficient of friction.



Nylon strings on a guitar can be easier on the fingers than steel ones.

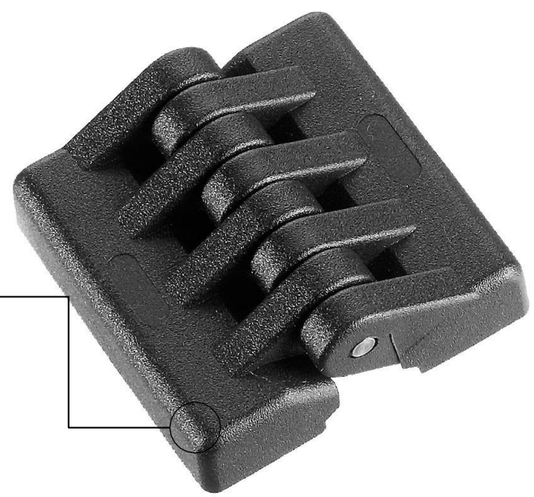


Nylon kitchen utensils will resist wear over a long period of time and not damage other kitchen equipment.



Gears in electrical/ mechanical products are normally nylon, because of its resistance to wear and low coefficient of friction.

Small nylon hinges and sections of knock-down-fittings are often made from nylon.





Being tough, durable and food safe makes nylon per-fect for these dog toys..

Thermoplastic Polymers

Polypropylene (PP)



Polypropylene is a versatile plastic that is easy to work with and can withstand repeat bending.



Polypropylene (PP) can be recycled and is represented by a number 5 in the recycling symbol.



Polypropylene is available in a range of colours and is one of the safest plastics for repeated use in storing food



Polypropylene can be widely processed using a range of techniques to produce a massive range of products.



First aid kits need to be green in colour, possibly contain a range of chemicals and be quickly transported around. Polypropylene's good chemical resistance, range of colours and durability make it ideal.

Excellent flex resistance made polypropylene the perfect choice in the designing of these chairs.

Any durable live hinges are best achieved using PP.

PP can be used in fast-food packaging as it has good high-temperature resistance.





Thermoplastic Polymers

High Impact Polystyrene (HIPS)



HIPS is inexpensive and easy to process. It is widely available all round the world



HIPS (High Impact Polystyrene) can be recycled and is represented by a number 6 in the recycling symbol. It is one of the most recycled plastics.



HIPS's good impact resistance, strength, stiffness and light weight makes it an ideal plastic for this movie prop helmet. HIPS is easy to process which means these complex shapes can be achieved through the most appropriate or available methods.



HIPS is the result of rubber particles being added to polystyrene to improve impact strength.



HIPS, and other member of the styrene family, is widely processed through all the standard techniques—such as injection moulding.

A model slot car uses HIPS for its body work. Its lightweight properties improve handling and its impact strength copes well when the car crashes. As HIPS is easy to process it can be used with the most efficient batch production methods.



Thermoplastic Polymers

Expanded Polystyrene



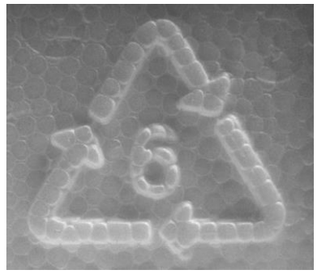
Expanded Polystyrene looks completely different to standard polystyrene.



It is usually white in colour and made of pre-expanded polystyrene beads.



It is normally used for it's impact absorbing and/or its thermal insulating properties.



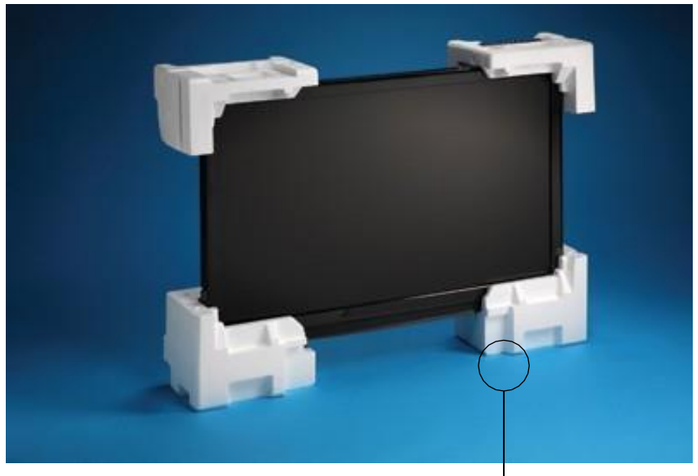
Expanded Polystyrene can be recycled and is represented by a number 6 in the recycling symbol.



Inside the outer shell of a crash helmet is the impact absorbing liner, usually made of expanded polystyrene. The function of this layer is to absorb impact. The polystyrene compresses absorbing much of the impact. This system is designed to work one time.That's why a motorcycle helmet should be thrown away after being involved in a significant blow.

Expanded Polystyrene is lightweight and very easy to work with making it a common in model and prop making.





Expanded Polystyrene's formability, impact absorbing properties and low weight mean it is commonly used to protect products in the packaging.

Thermoplastic Polymers

Low Density Polyethylene (LDPE)



LDPE is lightweight with low stiffness and rigidity. It is one of the most food safe plastics.



LDPE is flexible,



LDPE can be recycled and is represented by a number 4 in the recycling symbol.



Polyethylene bags are widely used from supermarket carrier bags to smaller clear bags.



LDPE is widely used for its good chemical resistance, which is why it the material of choice for engine oil bottles.

LDPE is relatively cheap and easy to process. It is low friction and has low water absorption which is why it is often used in the manufacture of children's toys.



Thermoplastic Polymers

High Density Polyethylene (HDPE)



HDPE is known for its large strength to density. It is used for a variety of food and drink packaging as well as other items in the construction and automotive industry.



HDPE is commonly recycled, and has the number 2 as its identification code



HDPE can be waxy to the touch.



HDPE is preferred by the pyrotechnics trade for mortars over steel or PVC tubes, being more durable and safer.



HDPE milk bottles are the most popular form of milk packaging in the UK with around three billion bottles used every year.

Plastic milk bottle manufacturers are responding to calls for 'greener' packaging and beginning to include recycled HDPE into bottles. Companies have worked together to develop a way of producing HDPE milk bottles using recycled content that meet all the relevant laws and regulations about safety and food packaging.



Thermoplastic Polymers

Polyvinyl Chloride (PVC)



PVC comes in two basic forms: rigid and flexible.



PVC is incredibly versatile and one of the most widely used plastics in the world. It is widely available and at low cost. Applications include a massive range of products.



PVC is commonly recycled, and has the number 3 as its identification code, however there are health concerns over its production and disposal.

Roughly half of the world's polyvinyl chloride is used for producing pipes for industrial applications.





uPVC, also known as rigid PVC, is extensively used in the building industry as a low-maintenance material



PVC can be made softer and more flexible by the addition of plasticizers. In this form, it is used in electrical cable insulation, inflatable products, and many applications where it replaces rubber.



Thermoplastic Polymers

Polyethylene Terephthalate (PET)



PET Is made to manufacture blow moulded bottles for mainly soft drinks.



PET can be semi-rigid to rigid, and it is very lightweight. It can be made very clear.



PET is commonly recycled, and has the number 1 as its identification code,

First developed by NASA for their space program, space blankets consist of a thin sheet of PET film that is coated with a metallic reflecting agent, making a surface which reflects up to 97% of radiated heat. The design reduces the heat loss in a person's body.





Because PET is an excellent water and moisture barrier material, plastic bottles made from PET are widely used for soft drinks.

Thermoplastic Polymers

Polycarbonate (PC)



PC has high transparent clarity.



PC is one of the toughest thermoplastics.



PC can be re-melted and reused, however it is energy intensive to process.



PC id often used as an a safer alternative to glass.

The drinks industry increasingly looks to PC to improve safety where broken glass may be a problem.



The iconic 1st generation iMac featured a PC casing.



PC's very tough and resistant properties combined with excellent clarity make it perfect for protective glasses.



Composites

Fibre Reinforced Composite Materials

Carbon Fibre

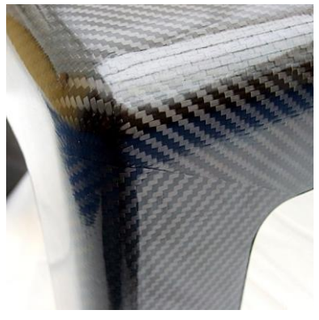




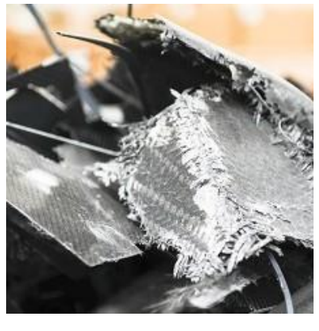
Carbon Fibre consists of shiny black fibres drawn from approximately 90% carbon.



Carbon Fibre's high strength to weight ratio make it a good material where weight reduction is important for performance



It has extremely high tensile strength and is four times as strong as high tensile steel.

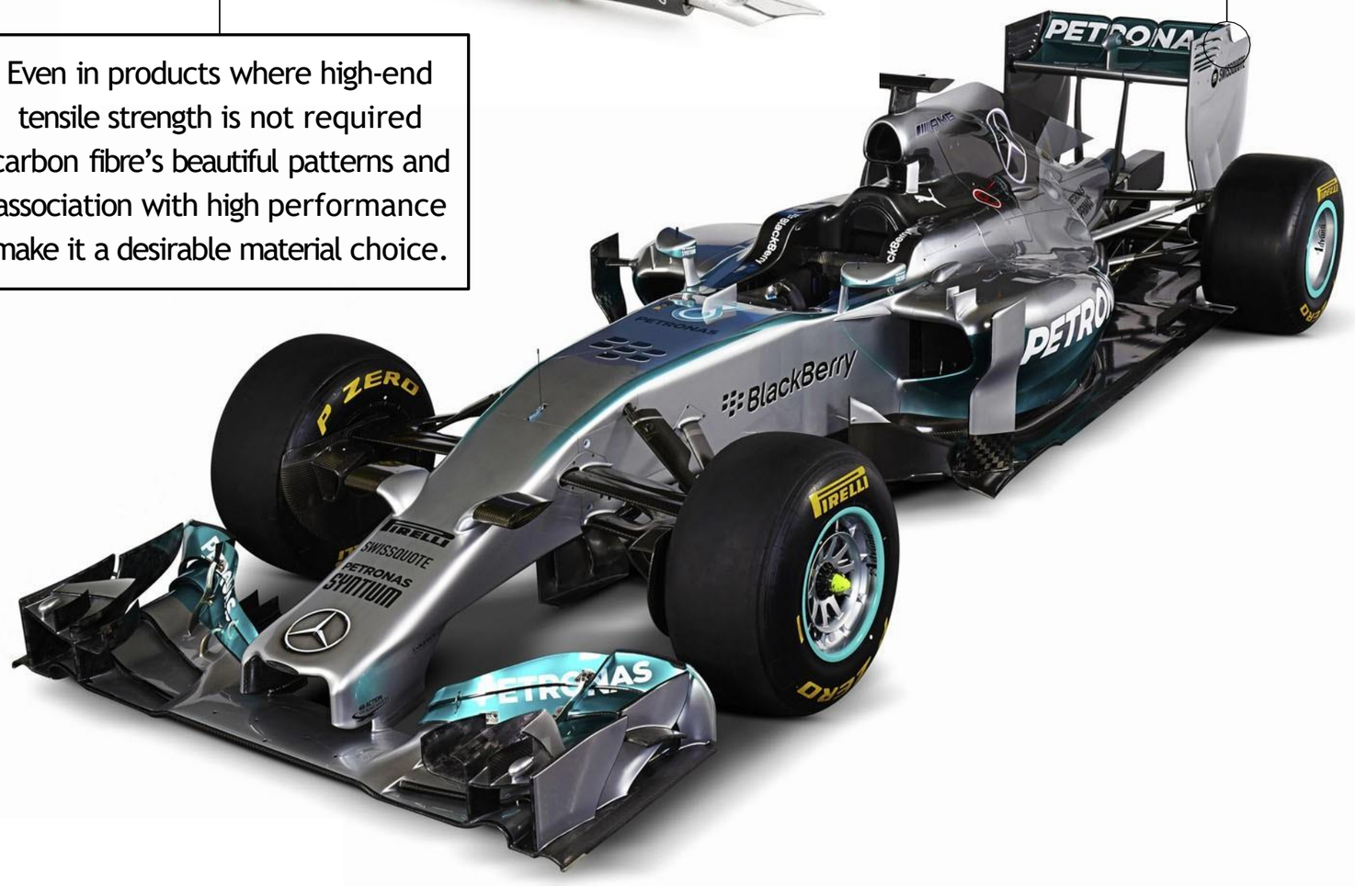


There are limited recycling options for Carbon Fibre.



Even in products where high-end tensile strength is not required carbon fibre's beautiful patterns and association with high performance make it a desirable material choice.

Carbon Fibre gives racing cars the advantages of a strong, lightweight and stiff chassis making it the material of choice in world motorsport.



Fibre Reinforced Composite Materials

Glass Reinforced Plastic (GRP)





GRP is a strong light-weight material and is used in a wide range of products



Laying up is the term used for the process involved in manufacturing with GRP.



The glass fibres can come in a range of thicknesses.



A mould is required for production in GRP.

Surgical casts were frequently made from plaster but now-a-days they are often knitted GRP bandages impregnated with polyurethane,These are lighter and dry much faster than plaster bandages.





Resistance to water and weather, a smooth finish, low maintenance, the ability to be moulded into complex shapes and easily coloured give GRP all the properties needed in slide manufacture.

GRP garden products are lighter and much more durable that traditional clay ones.



Fibre Reinforced Composite Materials

Kevlar





Kevlar fibres are woven into a cloth that can absorb force that would cause serious injury.



Kevlar is used to make a variety of clothing, accessories, and protective equipment safe. It's lightweight, durable and extraordinarily strong.



Some top end headsets include Kevlar reinforced cords. This makes them extremely durable and can help reduce intertwining.



Apple have produced phone cases with Kevlar outer shells.

Kevlar is five times stronger than steel and equal in weight, Kevlar body armour offers superior protection, yet is lightweight and comfortable enough to help improve mobility and reduce fatigue in the field.





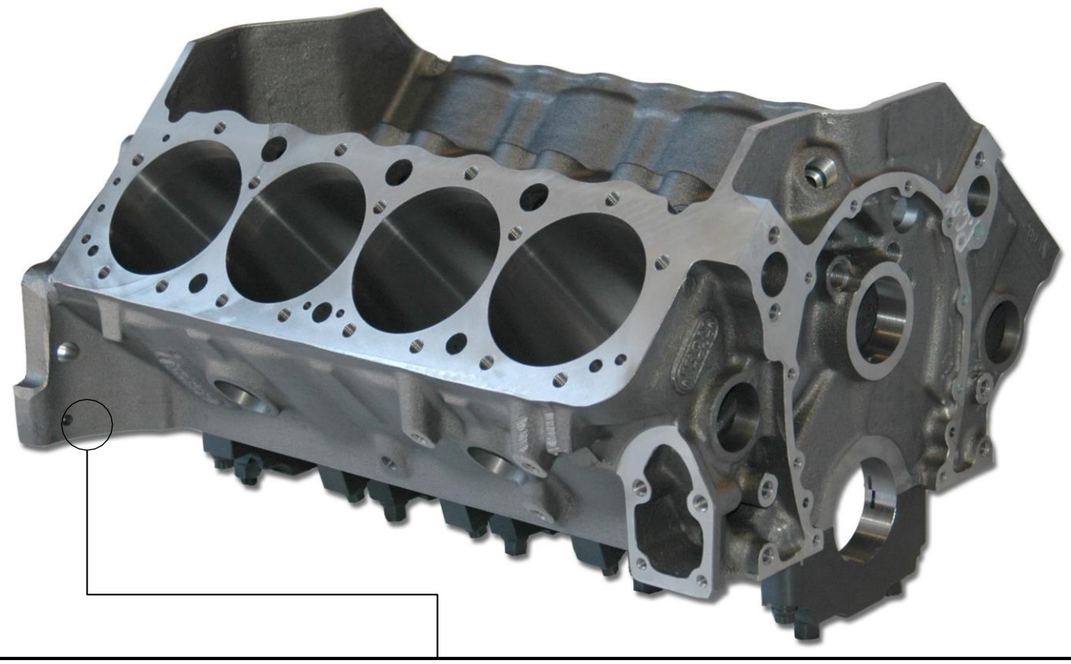
Kevlar fibres offer superb puncture, abrasion and tear resistance. Other benefits include a quieter ride and a reduction in rotational weight, which can help decrease engine strain, and typically results in improved fuel efficiency.

Metals and Alloys

Ferrous Metals

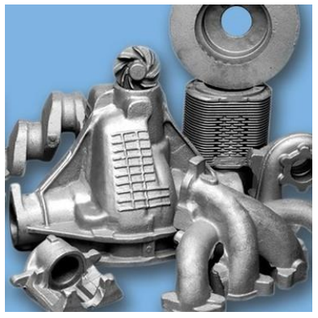


Cast Iron





Cast iron is iron or a ferrous alloy which has been heated until it liquefies, and is then poured into a mould to solidify.

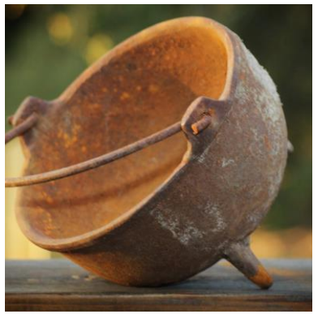


The element Iron is one of the most available elements on the planet and is widely used.

With its relatively low melting point, ability to be casted, excellent machinability, resistance to deformation and wear resistance, cast irons have become an engineering material with a wide range of applications such as engine blocks.



Cast Iron is a less ductile metal and is brittle due to its higher carbon content.

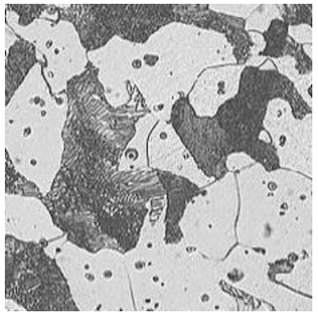


Cast Iron can have poor corrosion resistance.

Built in 1781 The Iron Bridge is a bridge that crosses the River Severn in Shropshire, England. it was the first arch bridge in the world to be made of cast iron.
Cast Iron is excellent in compression but weak under tension or bending, so the best way of using it for bridge construction was to use arches, so that all the material is in compression.



Ferrous Metals



Low Carbon Steel / Mild Steel



The Lower carbon content gives this steel higher ductility and toughness.



It is often used when large quantities of steel are needed, for example as structural steel.



Its price is relatively low and it provides material properties that are acceptable for many applications

Mild Steel is easily shaped into car body panels



Due to its poor corrosion-resistance, it must be painted or otherwise protected and sealed in order to prevent rust from damaging it.

Mild Steel has good tensile strength and ductility which make it ideal for the function and manufacture of this chain.



Ferrous Metals



High Carbon Steel



The higher carbon makes this steel harder but less ductile. It is used commonly in the manufacture of hand tools.



High Carbon Steels offer respond better to heat treatment and have a longer service life than mild-steels.



High-carbon steels typically have high wear resistance due to their superior surface hardness.



For best results wood planes need to be sharp. High Carbon Steels high wear resistance and ability to be sharpened make it ideal for this type of tool.

High Carbon Steel is harder but more brittle than lower carbon steels. It is still popular with many bush crafters and survivalists due to its toughness and ease of sharpening.



Non-Ferrous Metals



Aluminium

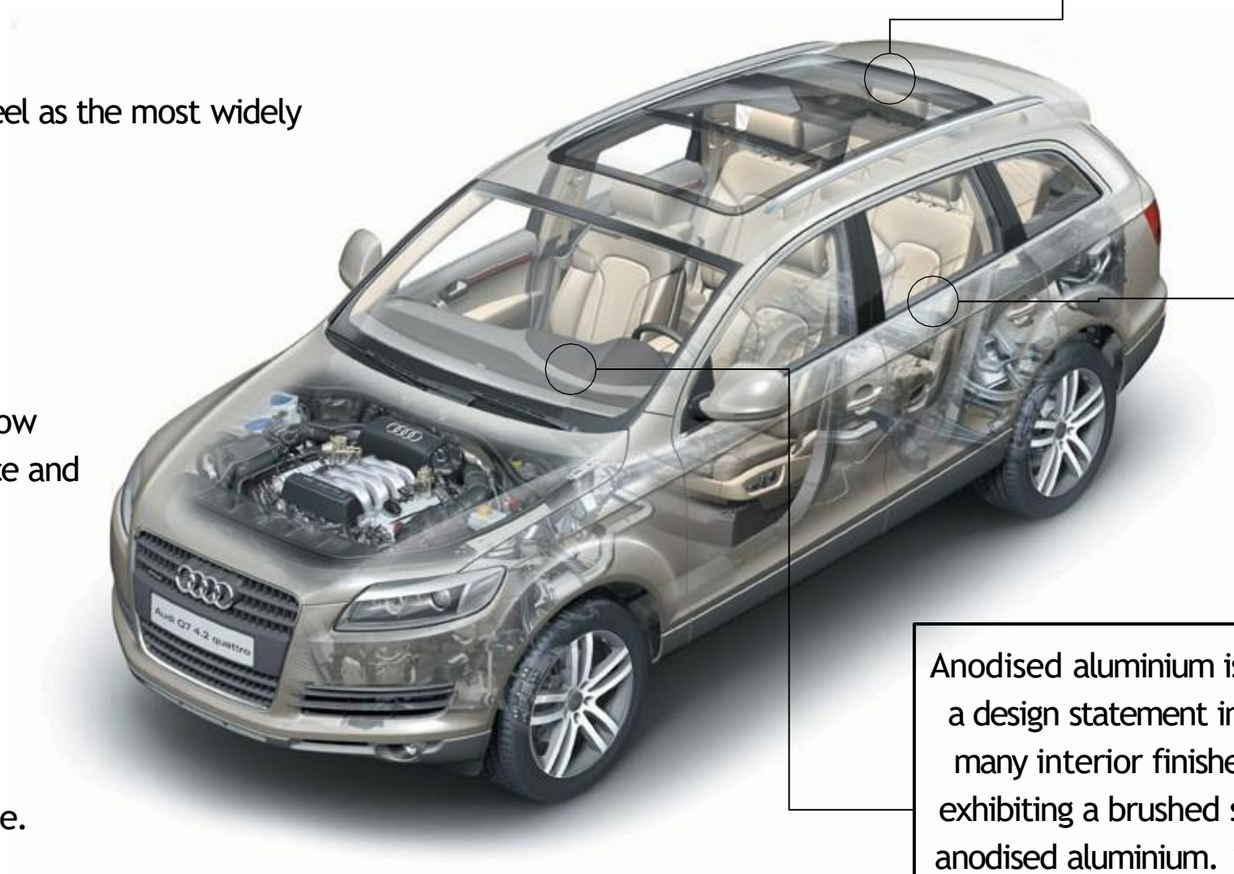
A guiding philosophy behind Audi's aluminium car bodies is to reduce weight and to increase performance. Making the car nimble, ridged. And corrosion resistant.



Aluminium is second to steel as the most widely used metal.



Aluminium has a winning combination on strength, low weight, corrosion resistance and it's recyclable.



Air-conditioning in cars has become standard nowadays. These are aluminium extrusions and drawn tubes which are now the norm for heat exchanger components.



Aluminium is extremely energy intensive to produce.

Anodised aluminium is now fashionable as a design statement in car interiors with many interior finishes and accessories exhibiting a brushed silver appearance of anodised aluminium. Scratch resistance, ease of cleaning and recyclability being additional benefits.

alu

Aluminium is 100% recyclable and nearly three quarters of all aluminium ever made remains in use today!



Apple's MacBook's are made from a single piece of aluminium called the unibody, which is milled using a CNC machine. It makes the MacBook rigid, strong and light.

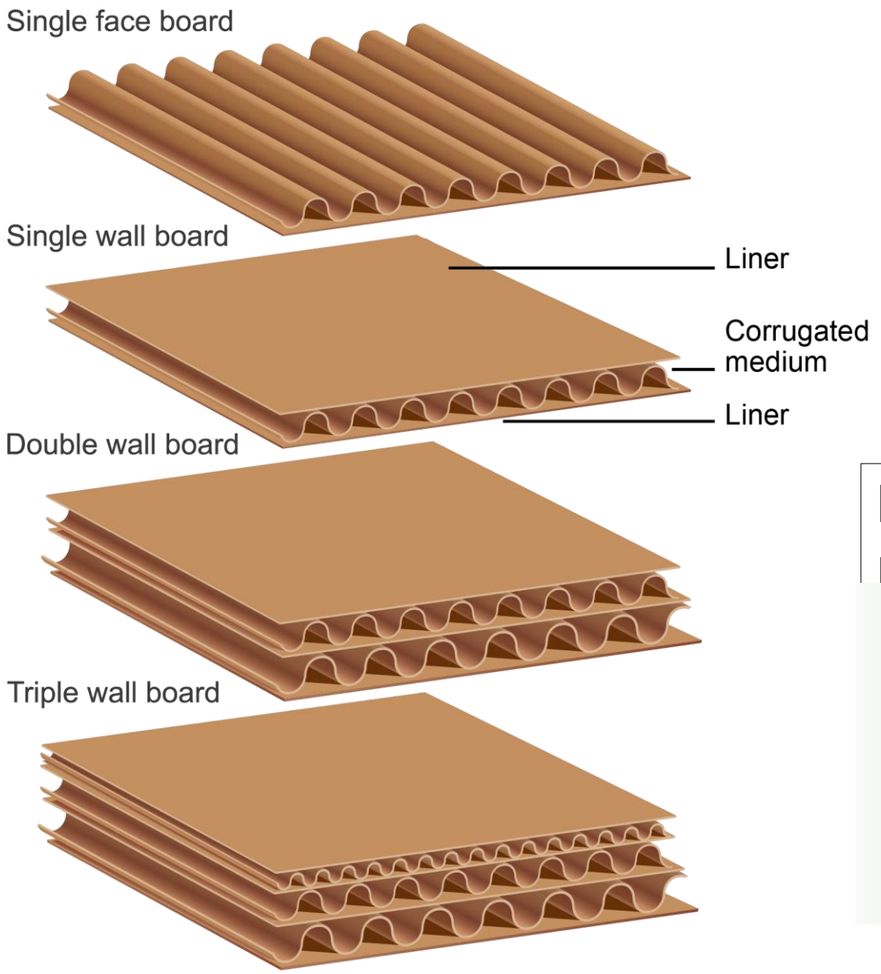
Papers and Boards

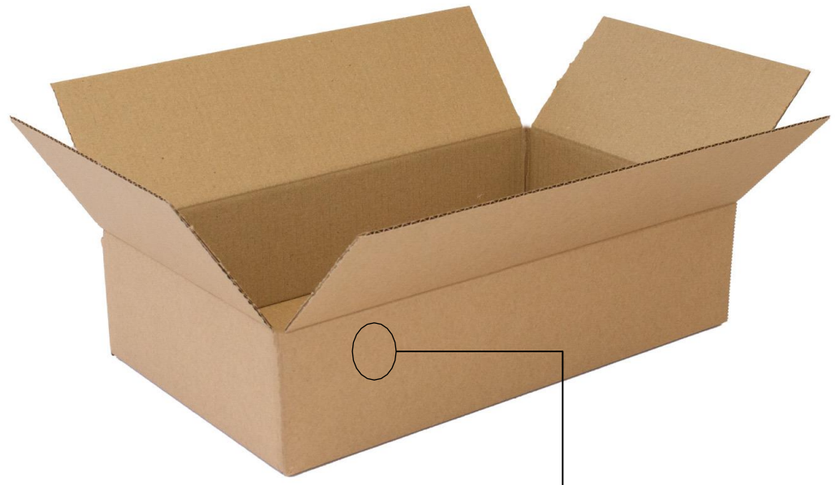
Papers & Boards



Corrugated card

Corrugated card is made up of one or two flat outer layers, called liners, and a corrugated medium





Flexible in the single layer form otherwise directionally rigid with a good strength to weight ratio

Fully recyclable



Shock-absorbing, lightweight and good thermal insulation make it perfect for packaging

The outer layer can be printed on for branding and advertising

Papers & Boards

Duplex board



Usually around 200-500gsm

It is food safe and can be coated to
increase water and oil resistance



This twin layered board is usually used for packaging

The top layer is normally white, but available in range of colours

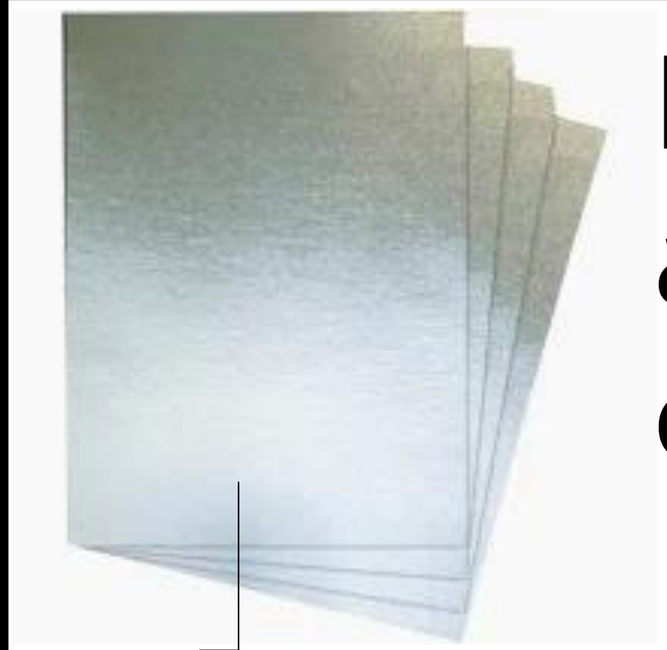
It folds, cuts and prints well







Papers & Boards



Foil backed and laminated card

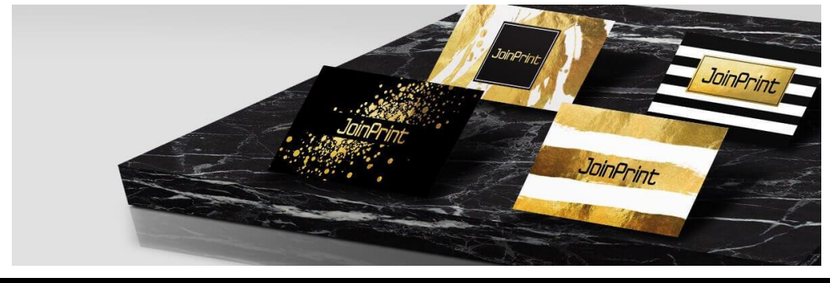
Some boards are coated or laminated with other materials to enhance their working properties

Polyethylene is used as a food safe liner, an adhesive between the card and foil layers and as an outer coating





Foil linings create an impermeable layer protecting the contents from light, air, odour and bacteria



Difficult to recycle due to laminated layers.

Papers & Boards



Bleached card

Bleached white card, also called solid white board, is highly brightened and treated on both sides

It is used for a range of products including high-end packaging and greeting cards







It holds print very well and has a luxurious feel to the surface

Usually available between 200 to 500gsm

Natural and Manufactured Timbers

Natural Timbers- Softwoods

Pine





lightweight, easy to work, can split and resinous near knots

Pale yellowish brown



From coniferous tress- pine



Uses: interior construction and furniture.



Natural Timbers- Softwoods



Larch



Pale reddish brown

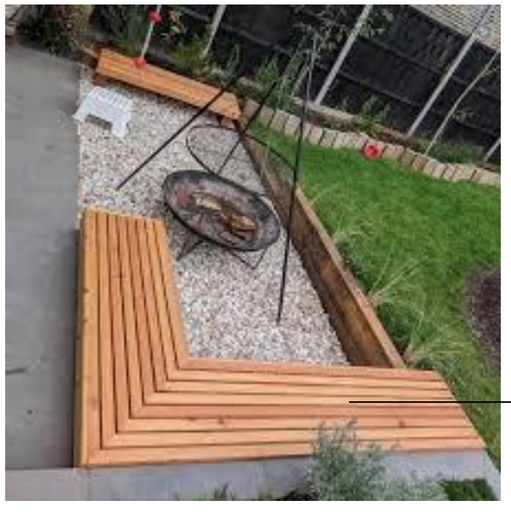
Durable, tough, good water resistance, good surface finish



Railway sleepers and veneers



Fades to grey when exposed to sunlight



Uses: Exterior cladding, decking, flooring, machined mouldings, furniture and joinery.

Natural Timbers- Softwoods

Spruce





Creamy white in colour



Easy to work, high stiffness to weight ratio.







Uses: Construction, furniture and musical instruments.

Natural Timbers- Hardwoods

Ash







Pale brown



Flexible, tough and its elasticity makes it shock resistant.



Uses: Sports equipment and tool handles

Laminates well



Natural Timbers- Hardwoods



Beech





Veneers

Beige with a pink hue





Fine finish, tough and durable.

Hard, tough and odourless so it is resistant to abrasion and does not affect the taste of food



Uses: Children’s toys and models, furniture



Natural Timbers- Hardwoods

Balsa



Pale cream/white







Very soft and spongy, good strength to weight ratio.





Uses: Prototyping and modelling

Natural Timbers- Hardwoods



Oak





Light brown

Veneers



Tough, hard and durable, high-quality finish possible, hardwearing and it's also resistant to rot when exposed to moisture.







Uses: Flooring, furniture, railway sleepers

Natural Timbers- Hardwoods

Mahogany







Reddish brown



Veneers





Easily worked, durable and finishes well.

Uses: High end furniture and joinery.

Textiles

Natural Fibres- Cotton

Cotton

Cotton is a soft, fluffy fibre harvested from the cotton plant's bolls



Renewable source



Range of clothing, towel, bed sheets



Biodegradable



Takes clothing dye well

Breathable and moisture-absorbing properties

Natural Fibres- Silk

Silk

Silk is source from the silkworm cocoons.





Luxury clothing, underwear, ties, night clothes



Biodegradable

Renewable source

Natural shine due to triangular structure

Soft, fine lightweight

Natural Fibres- Wool

Wool

Sourced from sheep, goats, rabbits, camelids





Jumpers, coats, suits, blankets, carpets, beanie hat



Renewable source

Breathable

Biodegradable

Durable

Warm, naturally crease resistant, can shrink

Synthetic Fibres- polyester

Polyester

Synthetic fibres are made from chemically produced polymers

Sourced from oil

Tough, strong hard wearing

Quick drying

Fleece, backpacks





Non-absorbent

Easy to care for



Threads, sportswear

Synthetic fibres

Polyamide (nylon)

Synthetic fibres are made from chemically produced polymers



Sportswear

Light weight
Quick drying
Crease resistant



Strong, hard wearing



Rope, webbing, umbrellas

It stretches to support movement

Durable

Sourced from oil

Synthetic Fibres- Elastane

Elastane

Synthetic fibres are made from chemically produced polymers

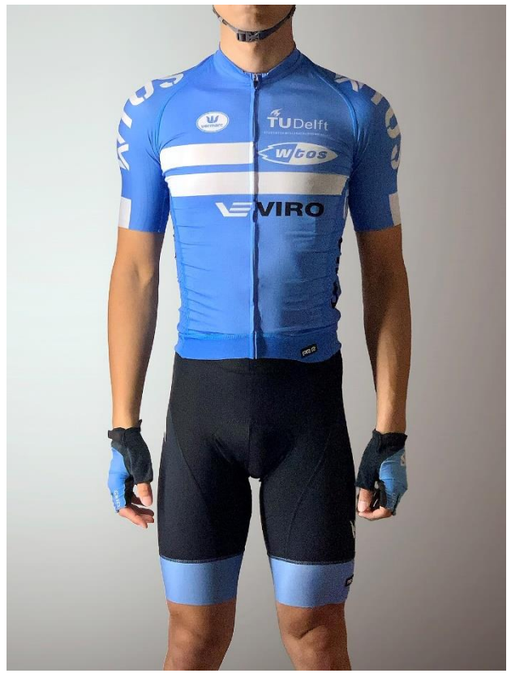
Lightweight, shape retention

Stretchy Fiber: Elastane, also known as spandex or Lycra



Sportswear, swimwear, surgical supports





Quick drying

Smooth, strong

Blended fibres- polycotton

Polycotton

Clothing and bed sheets



Durable and stronger than pure cotton

Blended and mixed fibres combine two or more types of fibres to provide a fabric with useful properties



Easy to care for

Cost-Effective

more resistant to wear and tear compared to 100% cotton.