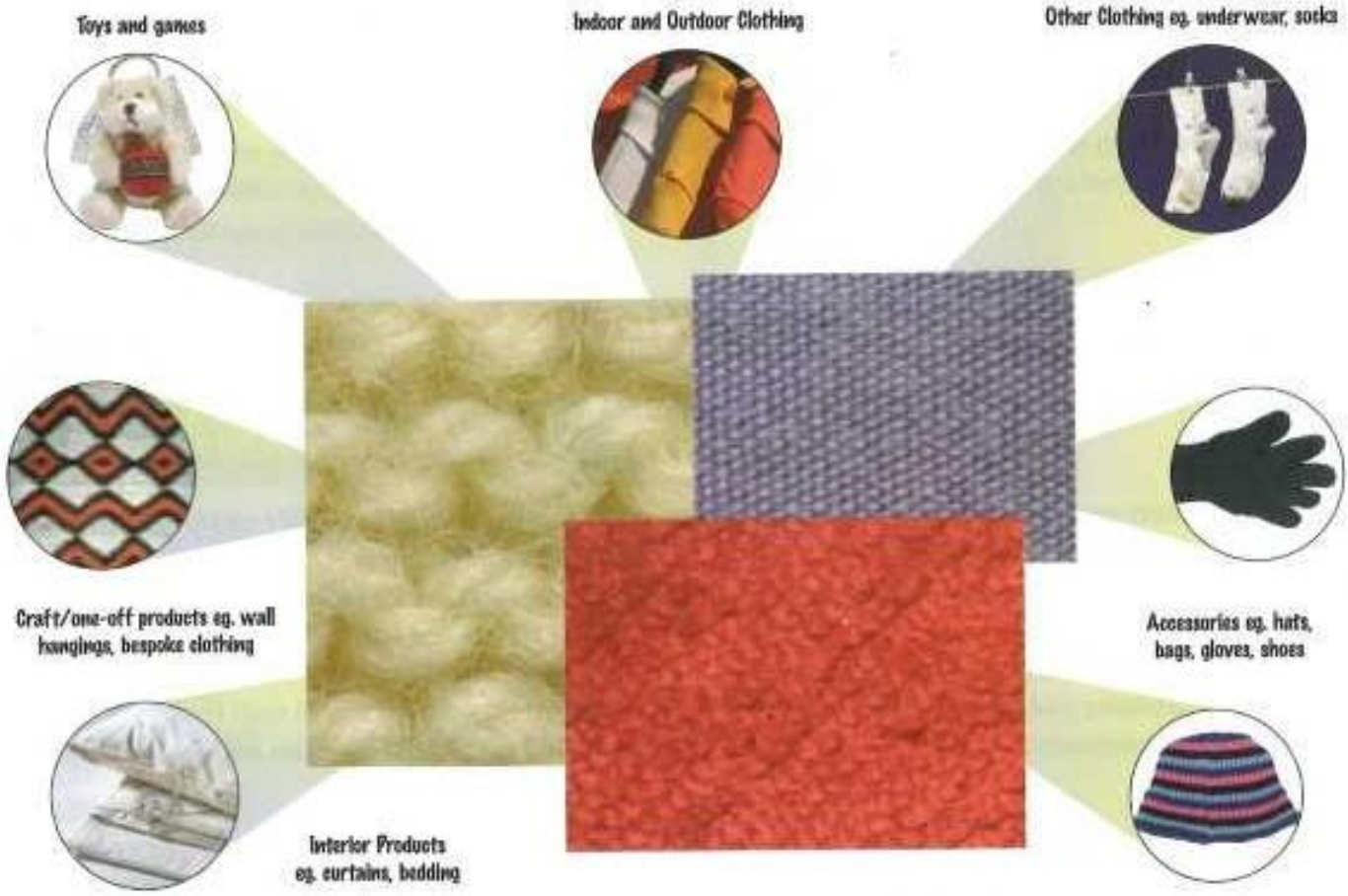
The Need For Textiles

Textiles play an important part in our lives and are essential for ...

1. General well-being
2. Comfort
3. Decoration
4. Protection from the elements

Textile Products

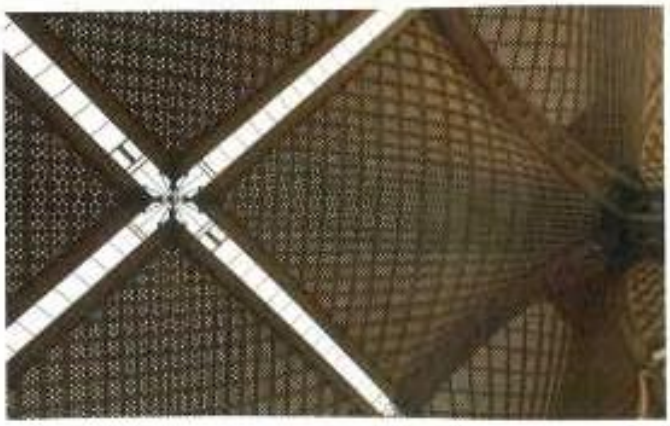
'Textiles' is a general term used to describe any product that is made from a fabric. That fabric can be knitted, woven or bonded. Textiles are all around us and there are many different kinds of textile products. The main types are shown below.



Advanced Uses

Textile materials are also used for a wide range of industrial purposes as well as other advanced uses. For example ...

1. Roads
2. Civil Engineering
3. Transport
4. Flooring
5. Medicine
6. Agriculture
7. Architecture
8. Specialised Protective Clothing



Choosing Equipment And Tools

The equipment or tools you choose to work with in Textiles Technology should be appropriate for the job they have to do. You will need to be aware of the Health and Safety issues associated with the use of both simple and complex tools and equipment. All the equipment used in Textiles has specific features to allow you to do the job correctly and effectively. As part of your exam preparation and when completing your practical portfolio you will be expected to ...

1. Describe tools, equipment and components.
2. Select appropriate tools, equipment or components.
3. Use tools and equipment safely, accurately and efficiently to produce quality products.

Equipment and components can be divided into the following areas:

1. Colour and design equipment.
2. Pressing equipment.
3. Sewing and joining equipment.
4. Advanced equipment.
5. Components (ie. items that can become part of the final design).

Colour And Design Equipment

BATIK POT

Batik pots are specially developed pots that are used to melt the wax that is used for Batik. There are different tools used to draw with the hot wax onto fabrics (see page 30).

SCREEN PRINTING EQUIPMENT

Screen printing is used as a method of applying pattern to fabrics. To do this you will need a screen with a special mesh and a tool called a squeegee to push the pigment through the mesh onto the fabric (see page 27).

FABRIC CRAYONS AND FABRIC PENS

Fabric crayons and pens are dyes in solid form. They can be used successfully on both synthetic and natural fabrics. They are heat set onto the fabric by ironing on the reverse of the design, they can then be hand washed safely at 40°C.

Pressing Equipment

IRON

Irons are used for pressing garments and also for finishing them.

HEAT PRESS

A heat press is a machine that can be used to transfer designs from a specially printed paper onto fabrics, or it can be used to pleat fabrics or create special effects.

Fibres

All fabrics come from fibres. On their own, fibres are weak but when they are twisted into yarns they take on different properties. They can then be constructed into fabrics. See page 12 for more details on the manufacturing process.
Fibres are tiny hair-like structures. They can either be short (staple fibres) or long (filament fibres).
There are three groups of fibres:

1. NATURAL FIBRES

These can be either animal or plant based. The main animal based fibres are wool and silk. Others include alpaca, angora, camel hair, cashmere, mohair, wild silk and vicuna
Plant based fibres are cotton, linen, jute, hemp and ramie.

2. SYNTHETIC FIBRES

These are man-made from oil-based by-products eg. elastomeric, acrylic, aramid, modaerylic, polyamide, polyethylene, polyvinyl chloride (PVC). Micro-fibres are fine synthetic fibres eg. polyester, nylon. Tactel is a micro-fibre trade name.

3. REGENERATED FIBRES

These are made from a combination of chemicals and cellulose waste eg. viscose, lyocell, acetate, cupro, modal, tencel.

Yarns

Yarns are fibres that have been twisted into long lengths and are wound onto spools or cones. They are made by spinning and twisting fibres together using one of two methods. The Worsted Spinning System produces a smooth yarn and the Woollen Spinning System produces a more hairy yarn. The yarn is spun in either an anticlockwise (S twist) or clockwise (Z twist) direction. When making more complex yarns S twist and Z twist are combined in equal amounts to prevent distortion. The different types of yarns are spun yarns, filament yarns, multi-filament yarn, monofilament yarn, assembled yarns, folded yarns, plied yarns, complex yarns, fancy yarns.

The Manufacturing Sequence

Fibres form the natural or synthetic starting point from which all fabrics are made. Yarns are fibres that have been spun into long lengths, which are then twisted and wound onto spools or cones. The following diagram provides an overview:

Origin Of Natural Fibres

1. COTTON

Produced by the seed boll of the cotton plant. This is HARVESTED by hand or machine and then DRIED before GINNING to remove all the seeds. The fibres then undergo CARDING and COMBING in order to get them to lie in the same direction. This creates slivers that are drawn into ROVING. SPINNING then stretches and twists the fibres into staple yarns.

2. WOOL

Produced mainly by sheep, which are shorn (SHEARING) every year. The fleece is then GRADED for quality and SCOURED to remove grease and dirt. CARBONISING then removes plant material such as leaves and twigs. CARDING and COMBING straightens the fibres using brushes and combs. Finally the fibres are SPUN to produce yarn.

3. SILK

Silk is produced by silk worms. The cocoons of the silk moth are HARVESTED and then HEATED to kill the developing pupae and to remove the GUM holding the cocoon together. The filaments are then SPUN to produce yarn.

Origin Of Synthetic Fibres

1. VISCOSE

This is a 'regenerated' fibre made from pine or beech wood pulp, which is PRESSED to form cellulose sheets. These sheets are then dissolved in an ORGANIC SOLVENT to form viscose solution, which is then EXTRUDED through small holes in a spinneret to produce fibres that are HARDENED OFF in a bath of chemicals. These are then stretched and dried before being wound onto a spool or cut into staple fibres. This is called WET SPINNING.

2. ACETATE

This is also a 'regenerated' fibre but here the wood pulp is treated with ACETIC ACID before going through a process similar to that of viscose above. The fibres are then extruded into a stream of warm air. This is known as DRY SPINNING.

3. POLYESTER

This synthetic fibre is produced by the POLYMERISATION (joining small molecules up to make long ones) of chemicals derived from oil. The polymer produced is melted and then extruded into a stream of cold air in a process known as MELT SPINNING.

4. NYLON

This fibre is produced in the same way as polyester above and also uses MELT SPINNING.

5. MICROFIBRES

These are synthetic fibres, which are less than one denier in thickness. Tactel is an example that is often used for sportswear, as it is 25% lighter than cotton.

Fabrics

Fabrics have all sorts of uses, such as clothing, automotive purposes, engineering, interiors and architecture.

There are four main types of fabrics:
- Knitted
- Woven
- Felted
- Bonded

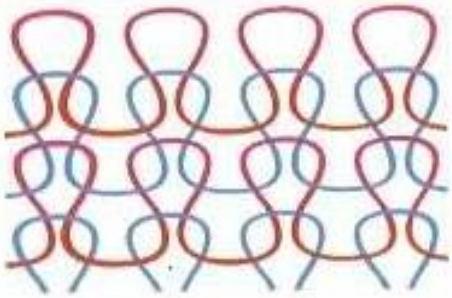
Knitted Fabrics

Knitted fabrics are made up of a series of interlocking loops.
These knitted loops make the fabric stretchy (elastic), which is one of the key features of knitted fabrics. Knitted fabrics can have further stretch or elasticity added by using Elastane (the best known is Lycra).

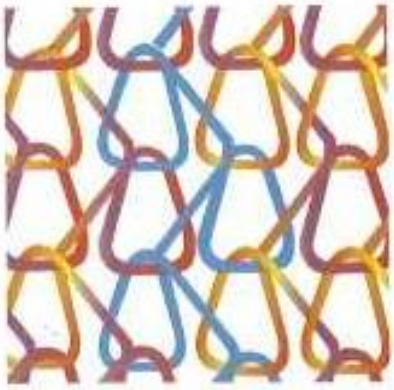
All knitted fabrics are made using one of 2 methods:

1. WEFT KNITTING

Weft knitting yarns are knitted in horizontal rows with horizontal ribs on the wrong side of the fabric and V shape loops on the face (right side) of the fabric. The loops hold the fabric together by interlocking above and below each row.



Fabrics produced using this method are single jersey (eg. t-shirts) and double jersey (eg. sports shirts), and also knitted sweaters.



2. WARP KNITTING

Warp knitted fabrics are created using a series of interlocking loops or chains, which run vertically along the fabric, similar to the warp yarns in weaving (see page 14). This process can only be done by machine. It tends to create a firmer fabric than weft knitting, which keeps its shape well and does not usually ladder when cut.

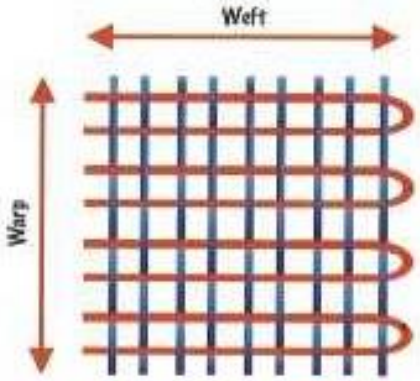
Fabrics produced using this method can be either fine and lightweight, such as nets and lace, or heavier such as terry toweling or velour.

Key Characteristics Of Knitted Fabrics

- Weft knits have more stretch or elasticity than warp knits.
- The addition of elastane gives knitted fabric more extension or stretch.
- Knitted fabrics are warm.
- Knitted fabrics can be bulked up using a finishing process called napping or brushing, which gives the finished fabric a fluffy surface. This process can be applied to products such as fleeces.

Woven Fabrics

Woven fabrics are constructed using interlocking threads or yarns. The fabrics are produced on a machine called a weaving loom. The yarns that run horizontally across the fabric are called Weft yarns, and the ones that run vertically down the length of the fabric are called Warp yarns.



Types Of Weave

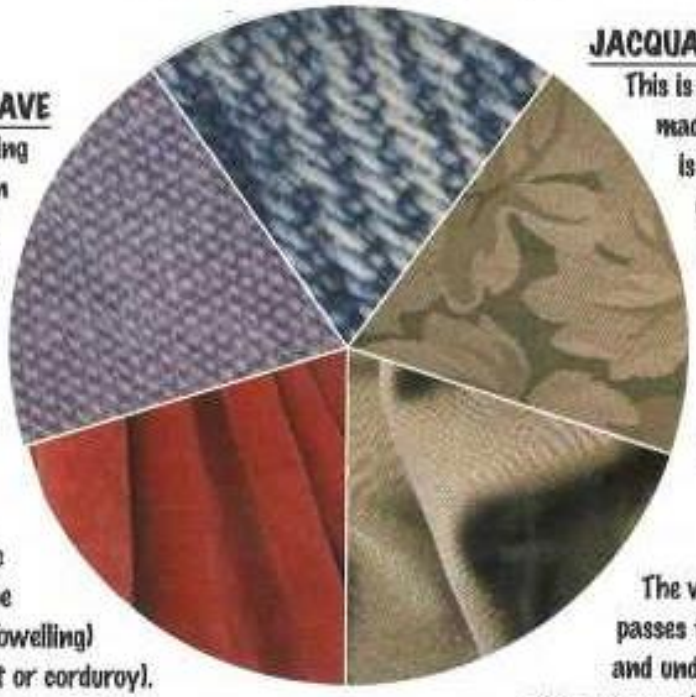
There are many types of woven fabrics. The weave that is chosen for a textile product will depend on its intended use.

TWILL WEAVE

This weave creates a diagonal pattern where the weft yarns pass over and under either 2 or 4 warp yarns eg. denim or gaberdine.

PLAIN WEAVE

The simplest weave consisting of an interlocking pattern where the weft yarns pass over and under the warp yarns eg. polyester cotton or calico.



JACQUARD WEAVE

This is a complex woven fabric. It is made on a specific type of loom that is called a Jacquard loom, which is often controlled by a computer. The fabrics produced using this method are very expensive and are of a high quality. Typical products are rich furnishings and formal wear, such as wedding waistcoats.

PILE WEAVE

This is a woven fabric with a pile that can be made of loops (as in Towelling) or thread as in (velvet or corduroy).

SATIN WEAVE

The weave for this fabric passes the weft yarns over and under between 4 and 7 warp yarns, giving a smooth shiny fabric. This is used in furnishings eg. damask.

Key Characteristics Of Woven Fabrics

- They fray easily when cut.
- They are strongest along the straight grain of the fabric.
- They don't stretch much, though the addition of elastane (Lycra) can give the fabric more extension.
- A close weave gives a stronger and firmer fabric than a loose weave.

Non-woven Fabrics

Non-woven fabrics are made with raw fibres, which have not been made into yarns first. The fabrics can be ...

1. Treated with a chemical to matt them together.
2. Woven or knitted together before being felted using heat.
3. Stitched together in layers.

Non-woven fabrics can be further broken down into the following categories:

1. WOOL FELTS

Wool felts are made by laying a web of fibres on a belt, treating it with a solution, then heating it. Finally, the web is passed through a range of mechanical rollers, which mat the fibres together.

2. NEEDLE FELTS

When making needle felts the fibres are laid on top of each other, and then passed through a series of barbed needles. The fibres are dragged or pulled backwards and forwards and up and down, which interlocks the fibres together to form a fabric. The addition of different coloured fibres means patterns can be created.

3. BONDED FIBRES

Bonded fabrics are made by laying the fibres across each other either randomly, or in a specific manner using specialised machinery. The finished fabric can then be bonded in the following ways ...

- Using an adhesive to glue the fibres together
- Using a solvent to soften the fibres, making them stick together
- Using stitching to fix pieces together. Stitch bonded fabrics are made by laying fabrics all in one direction and securing them using stitching lines – a cheap way of producing fabrics.

The fabrics are then fused together, using heat, to create the final fabric.

Other Fabrics

RUBBER – Fine latex (another name for rubber) can be moulded and shaped into seamless clothing, such as wetsuits, or clubwear.

NET – A mesh based material formed by twisting two ends of yarn together. It can be used for interiors and packaging.

LACE – Made by machine and manufactured on a net base. It is used primarily for interior products and special occasion dresses, such as wedding dresses.

METALS – Steel, copper or aluminium can now be made into really thin yarns. These can be used in knitted, woven, and non-woven fabric products, such as electronic 'smart' fabrics.

GLASS – These fibres have a high reflective surface but poor abrasion qualities. They are used for specialised textiles products such as industrial or architectural products.

CERAMICS – They can be combined with polyester fibres. They are waterproof, have UV protection and can help to maintain body temperature when added to other fabrics. They can be used in specialist garments for extreme weather conditions.

PAPER – Paper-like fabrics eg. Tyvek are already being used for clothing.

Key Characteristics Of Non-woven Fabrics

- Bonded fabrics do not fray easily.
- They have no grain.
- They do not stretch.
- They are not as strong or flexible as knitted and woven fabrics.
- They are permeable.

Choosing Fabrics

Designers must always try to choose the best fabric for the job, whether it is for clothing, interiors, accessories or sportswear.

In your coursework you have to identify the most appropriate fabric to use to construct your product. When choosing your fabric you need to consider the following ...

- If you need a natural or synthetic based fabric.
- If you need a fabric with high abrasion qualities.
- If you need a fabric that is cool or warm to wear.
- If you need a fabric that will offer protection from wind or rain.
- If you need a fabric that will offer special protection eg. fire protection.

From this information you can then decide which fabric or fabrics have the best qualities for your requirements.

Properties

Each fibre and fabric has certain qualities or properties that make it good to use when manufacturing products eg. cotton is cool, wool is warm, polyester dries quickly. These properties are taken into consideration when the fabrics are being chosen for a product. If the fabrics for a product need to be cool and hardwearing then the designer can look at the range of fabrics available on a chart similar to the one on the next page and decide on the most appropriate. Some fibres have better qualities or properties than others.

Mixing Properties Of Fabrics

The properties of a fabric can be enhanced when fibres are combined together. This is called a blend or a mixture. Textile and fabric manufacturers will blend or mix fibres depending on the product that is to be produced. This process can enhance the qualities of the resulting fabric giving it the combined properties of both fibres. One of the best-known blends is that of polyester and cotton, called 'poly/cotton'.

The mixing and blending of fibres also means that the end product can be cheaper to make and sell. Another well-known blend is polyester and wool.

PROPERTIES OF FIBRES AND FABRICS II

	CLASSIFICATION	ORIGIN	STRENGTH	ELASTICITY	ABSORBENCY	CREASE RESISTANCE	DURABILITY	WARMTH	FLAMMABILITY	GENERAL DESCRIPTION	
COTTON	Natural/ vegetable	Seed balls of the cotton plant	★★★★	★	★★★★	★	★★★★	★★	★	*A cheap, strong but cooling fabric, which creases fairly easily. Used for denim, damask, piqué, gabardine etc.*	
WOOL	Natural/ animal	Fleece from various sheep	★★	★★★★	★★★★★	★★★★	★★	★★★★★	★★★	*A soft, hardwearing fabric that is unlikely to crease much. Used for flannel, jersey, serge, shetland and tweed.*	
SILK	Natural/ animal	Cocoon produced by silk worm	★★★★	★★★★	★★★★★	★★★	★★★★	★★★★	★★★	*An expensive fabric that is smooth to the touch and drapes well. Cooling. Used for chiffon, satin, taffeta.*	
LINEN	Natural/ vegetable	The stems of flax plants	★★★★	★	★★★★	★	★★★★	★	★	*Even stronger when wet, linen is very cooling but creases easily.*	
VISCOSE	Manufactured/ regenerated	Cellulose extracted from wood pulp	★★	★	★★★★★	★★	★★	★★	★★	*A cheap light material though not particularly strong. Very versatile and used in all sorts of clothing from lingerie to suits.*	
ACETATE	Manufactured/ regenerated	Cellulose extracted from wood pulp	★	★★	★★	★★	★	★★	★★	*Like viscose, it is resistant to biological breakdown and very versatile.*	
RAYON	Manufactured/ regenerated	Cellulose extracted from wood pulp	★★★	★	★★★★	★★★	★★	★	★	*Referred to as synthetic silk, used for lightweight clothing.*	
POLYESTER	Manufactured/ synthetic	Chemicals from oil are polymerised	★★★★	★★★★	★	★★★★	★★★★	★★	★★	*A good all round synthetic, which is often blended with cotton to add crease resistance.*	
NYLON	Manufactured/ synthetic	Chemicals from oil are polymerised	★★★★	★★★★	★	★★★★	★★★★	★★	★★	*Like polyester it is strong and crease resistant. Its toughness makes it suitable for carpets.*	
ACRYLIC	Manufactured/ synthetic	Manmade fibres derived from synthetic polymers	★★★	★★★★	★	★★★	★★★	★★★★	★	*A warm fabric used for jumpers and bedding.*	
ELASTANE eg. lycra	Manufactured/ elastomeric/ synthetic	Synthetic polymer (85% polyeurethane)	★★★	★★★★★	★	★★★★★	★★★★	★★	★	*A durable fibre used in sportswear, leggings and jeans*	
MICROFIBRES	Manufactured/ synthetic	Chemicals from oil are polymerised	★★★★	★★★★	★★★	★★★	★★★	★★★	★★	*These tiny fibres can be woven so closely that they can prevent penetration by water, whilst allowing the fabric to 'breathe'.*	

Key – ★★★★★ = excellent; ★ = poor; blank = very poor

Other properties or factors to be considered when looking at fibres and their properties are:
- Wearability – How does the fabric feel when it is worn? Does it drape well?
- Comfort – How comfortable is the fabric when worn next to the skin?
- Launderability – How well it can be washed, maintained and cared for? You need to know fibre origins in order to know how to care for the product once it is made.
- Safety – Are there any safety issues to be considered when using this fabric?

Other attributes to be considered are the visual impact (how it looks) and the aesthetic quality (the design) of the fabrics.

Making Use Of Special Properties

Manufacturers often use fibres, yarns or fabrics that have been enhanced or have certain built-in qualities. For example, a cyclist will need to wear shorts that are comfortable, able to stretch and keep their shape. Therefore, the shorts will need to have a high elastane content.
These qualities can also be added to the textile product once it has been made.

Fibres And Fabrics With Special Properties

ELASTANE
The best-known fibre of this type is called Lycra. Because it is an elastane it is has high stretch as one of its properties. Stretch is also known as extension or elasticity. The main use for it is in sportswear and underwear, but you will also find it in garments such as suits. The benefit of adding Lycra to these types of products is that it improves the comfort and appearance of the fabric. Lycra is made by a company called Dupont – visit www.Dupont.com to see more detailed information about it.

RECYCLED AND BIODEGRADABLE FIBRES
These are made from fibres that have been recycled from plastic water bottles or PTFE or PET. Companies such as Malden Mills who produce Polartec www.polartec.com and Patagonia www.patagonia.com use these types of fibres to produce fleeces, which are lightweight and breathable. These products are also biodegradable due to the processes that they have gone through.

MICROFIBRES
These are small fine fibres up to 60 times finer than Human hair. They are normally made from either Polyamide or polyester fibres eg. Taetel.

NOMEX
A key fibre, it has been developed for use by fire fighters etc.

KEVLAR
This material is hardwearing. With the use of chemicals, it can be stiffened up or made as soft as fabric, depending on the end use. It is five times stronger than steel. It can be used for gloves, protective jackets or bullet-proof vests.

FABRICS WITH A MEMBRANE
These are fabrics that allow air in and out but do not allow moisture in. An example of this is Gore-Tex. (see page 24 for more details)

BIO STEEL
A genetically modified fibre that contains casein from goats' milk and the protein silk from spiders' webs. The two products are combined together to give a bullet-proof vest that can be recycled.

SYMPATEX
One of a new range of fibres that consists of a hydrophilic membrane. It is breathable and waterproof. One of its main uses is in extreme weather conditions.

Physical Finishes

Name Of Finish	Fabrics It Can Be Applied To	How It Is Done	Possible Application
Brushing	Cotton, wool, polyester, polyamide	Fabrics are passed between a series of wire rollers which brush the fabric leaving it soft and fluffy	Bedding, fleece 
Calendering	Cotton, wool	Fabrics are passed between heated rollers which give a smooth finish to the fabrics	Chintz fabric for furnishing 
Laminating	Cotton, Polyester	This is a process that bonds layers of fabric together using heat or adhesive eg. Gore-Tex	Outdoor clothing 
Embossing	Synthetic fabrics	Synthetic fabrics are passed through pattern engraved heated rollers, which leave the embossed pattern on the fabric	Furnishing fabrics 
Laser	Cotton, Synthetics	A pattern is drawn onto the surface of the fabric	Decorative patterns on fabrics 

Biological Finishes

Name Of Finish	Fabrics It Can Be Applied To	How It Is Done	Possible Application
Biostoning	Cotton, Tencel, Lyocell	A process of subjecting the fibre to cellulase enzyme as an alternative to rubbing with pumice.	Clothing 
Biopolishing	Cotton, Tencel	A process of adding a sheen to the fabric using a biological enzyme	Clothing 

Chemical Finishes

Name Of Finish	Fabrics It Can Be Applied To	How It Is Done	Possible Application
Mercerising	Cotton	The fabric is placed in a sodium hydroxide solution, which makes the fibres swell. This makes the cotton more shiny, absorbent and stronger	Clothing 
Waterproofing or water repelling	All fabrics	Chemicals, usually silicone-based, are sprayed on. This creates a protective barrier	Clothing, tents 
Flame proofing	Cotton, linen, rayon	Chemicals are applied either at yarn or fabric stage. The aim of this finish is to slow down the burning process	Interior fabrics, furnishings 
Stain resistance	All fabrics	A silicone-based finish is applied, which stops the absorption of stains or dirt	Clothing, interior products 
Anti-static	Synthetic fibres, acetate, silk	A chemical based product is applied, which stops the build up of electrostatic charge in fabric	Underwear, carpets 
Anti-felting	Wool	The fabric can have an oxidative finishing treatment applied to soften the scaly fibres of the wool, or it can be coated with a synthetic polymer film. This retains the warmth of wool but prevents felting.	Clothing 
Bleaching	Cotton, linen	Bleach is added to remove the natural colour of the fabric. This process can also weaken the fabric	Clothing, bedding 
Crease resistance	Cotton, Linen, Rayon	A resin is applied to the fabric, which is then heat cured to set it	Clothing 
Shrink resistance	Wool	A resin based finish can be applied, or a chemical treatment with chlorine can be used. Products labelled Machine washable or superwash have this finished applied	Clothing 

New Types Of Finishes

Textile and fashion manufacturers are always researching and developing new products and ideas. In order to do this they look at new ways in which textiles can be used in all sorts of environments and situations for a wide variety of products.

Type Of Finish	What It Is	What It Is Applied To
Ultra-violet Protection	Some fabrics have a Ultra-violet Protection Factor (UPF) value in the fabric. Others have dyes/threads in the fabric which change colour in sunlight	Clothing
Fire Retardant Qualities	This finish can be added to all fibres. It provides protection against heat and flames, which makes textile products non-flammable or difficult to ignite	Clothing (eg. nightwear), automotive products, furnishing products (especially for use in public buildings)
Spark Resistance	To protect against spark discharge in industrial settings	Emergency services, military products and some manufacturing operators
Fire Resistance	Means that the fabrics have to withstand certain fire conditions	Interior products, emergency services products
Cut, Tear, Ballistic Resistance	To protect the user in industrial or sporting events	Body armour, emergency services clothing, sportswear and some industrial employees
Abrasion Resistance	To prevent wear and tear of the garment	Body armour, emergency services clothing and sportswear
Membrane Systems	To allow air and moisture out, and/or not let moisture in	Outdoor wear, weatherproof clothing, tents, bags
Weatherproofing	To protect against the elements	Sportswear, tents, outdoor wear
Thermal Insulation	To keep you warm using temperature regulation	Skiwear, extreme sportswear
Chemical Protection	To protect the product from smells and chemicals	Military wear, protective clothing, upholstery
Buoyancy	To add bulk in order to keep you afloat	Swimwear and protective clothing
Reflective Qualities	Reflective yarns, inks and finishes	Protective and emergency services clothing, novelty wear, club wear and outer clothing
Phosphorescence	For garments where high visibility is needed. Give high visibility signals in dark areas	Protective clothing, novelty wear, club wear and outer clothing
Micro Encapsulation	Adding scents or vitamins to a product	Underwear, clothing, tights, bedding
Antibacterial	To provide additional protection to the body or aid healing	Underwear, bedding, sportswear, medical
Anti-allergenic	To reduce reaction to living conditions	Mattresses and bed linen