WOOL – THE NATURAL FIBRE

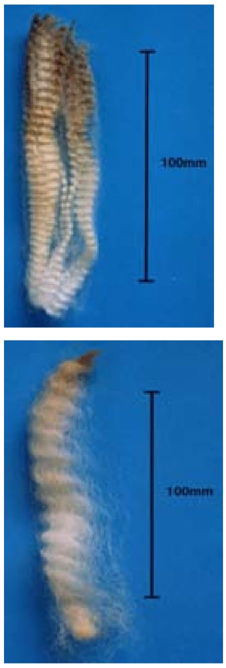
Wool is an extremely complex protein fibre, evolved by Nature over millions of years for the protection of sheep in a great variety of climates and conditions throughout the world.

The qualities that make wool so useful are genetically built into every fibre on the sheep, and hence depend largely on the breed. In one square centimetre of skin of a Romney sheep, around 2,000 fibres are to be found. On a Merino sheep, which produces much finer wool, there are approximately 8,000 fibres per square centimetre. A Merino wool factory produces around 3,000 km of fibre in a year!

Wool fibres grow in small bundles called ‘staples’, which may contain thousands of fibres. The size and shape of the staples varies between breeds. In Merinos it is blunt ended, while in coarser-woolled sheep such as the Romney the staple tapers towards the tip.

Staples have a regular wavy pattern from end to end called ‘crimp’. The finer the wool the smaller the crimp spacing.

Wool fibre is so resilient and elastic that it can be bent and twisted over 30,000 times without danger of breaking or being damaged. Every wool fibre has a natural elasticity that allows it to be stretched by as much as one-third and then to spring back into place. This durability and resilience makes wool an ideal fibre for carpets. And the superior resilience of wool enables wool fabrics to resist wrinkling and to drape gracefully.



Staples from fine-woolled (upper) and coarse-woolled (lower) sheep

Wool ‘breathes’

Under a microscope a wool fibre is seen to be covered by a thin sheath of overlapping scales that act rather like tiny roof tiles.

The scales cause liquid water to form beads and roll off. This enables a wool fabric to repel moderate rain and spills.

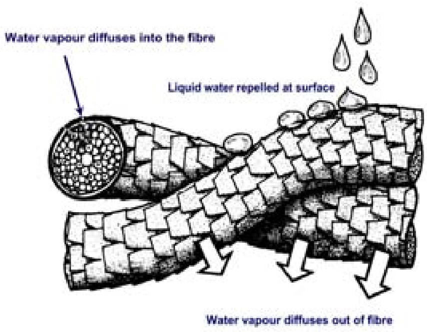
In contrast, wool absorbs water vapour (from the air or from perspiration), through the porous coating over the scales. Hence wool can absorb up to 30% of its own weight in moisture – without feeling clammy. Damp wool fabric remains absorbent and comfortable inside because its outer surface releases this moisture through evaporation.

Wool fibres strive to stay in balance with the surrounding moisture conditions – this is why wool is said to breathe as it absorbs and evaporates moisture.

A magnified wool fibre

Wool generates heat

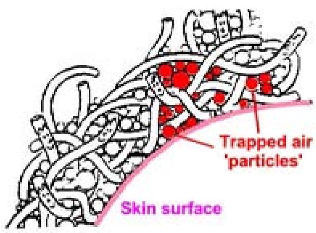
When moisture enters the fibre (for example, when we go outside on a cold, damp day), a significant amount of energy is released. This enables a wool jersey or other garment to provide a warming effect while the moisture is being absorbed. Every kilogram of wool generates about as much energy as the human body metabolism produces in one hour. And when you return to a dry, warm indoor environment, the moisture is released and a cooling effect is the result.



Wool the insulator

Wool also provides us with warmth through its insulation properties. In a wool garment the crimp in the fibres makes them stand apart from each other. As a result, little pockets of still air are trapped between the fibres. This lining of air trapped inside the fabric acts as an insulator (as well as the layer between the fabric and the skin).

Still air is one of the best insulators found in nature – ask any polar bear or penguin who relies on the insulating air layer formed by fur or feathers to keep warm in Arctic conditions.



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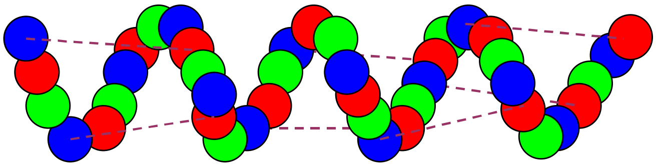
The ‘alpha helix’ of wool structure

At the most basic level, the molecular structure of wool fibres can be likened to a string of beads arranged in a helical path. The helix behaves like a spring and gives wool its flexibility and elasticity. The hydrogen bonds (shown as dashed lines), which link adjacent coils of the helix, provide a stiffening effect, especially when the fibre is dry.



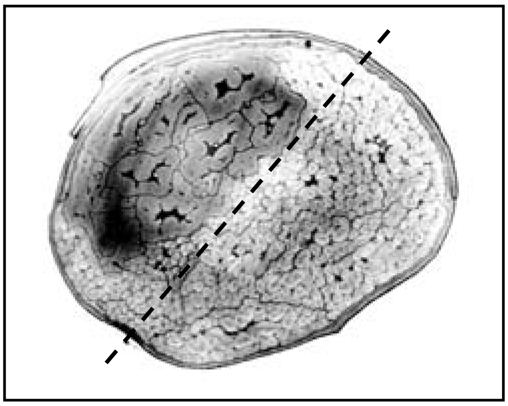
Why do some wools have more crimp than others?

The interior of a wool fibre is built of long tapering cells, which fit together rather like bricks and mortar. If a transverse section of a wool fibre is viewed in a high-powered microscope, two distinct types of cells may be seen, each comprising roughly half of the fibre cross-section, as shown below.

The two types of cells absorb moisture to different extents, hence they expand or contract by different amounts and this causes a bending of the fibre. The net result is a regular curve in the form of a crimp pattern along the length of the fibre.

The ‘two-halves’ arrangement of the cells is generally found in finer wools, hence they have a finer and more distinct crimp pattern. The arrangement of the two types of cells in coarser crossbred wools is not usually of the ‘two-halves’ type, and consequently these wools generally do not have such a compact, well-defined crimp.

Because low-crimp fibres are straighter than crimpy fibres, they reflect light more effectively like tiny mirrors. Hence the wool appears relatively shiny or ‘lustrous’.



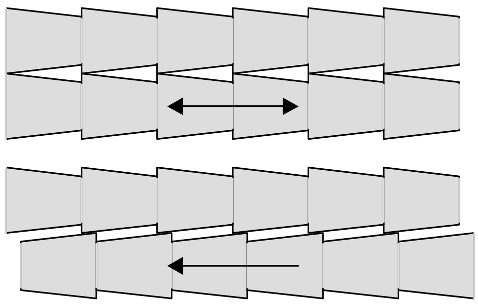
ABOVE: End view and side view of an ideal wool fibre with crimp

LEFT: Cross section view of a Merino wool fibre showing the two types of cells grouped in two halves

Felting and shrinking

The surface scales of the fibres are also responsible for the unique felting and shrinking properties of wool when wet. As these diagrams show, the edges of the scales catch against those of a neighbouring fibre aligned in the opposite direction so that they can easily past each other in only one direction. On the other hand, fibres aligned the same way will slip past each other easily in either direction.

Smoothing the scale edges by applying a special resin coating to the wool fibres prevents shrinkage. Inter-fibre slippage is made much easier.



Wool’s other ‘ewe-nique’ properties

- Because wool contains moisture it doesn’t allow static electricity to build up. Hence wool fabrics do not cling to the body. In addition, wool does not attract dirt particles and so remains clean and dust-free.
- Wool is naturally safe – its chemical composition and the presence of moisture enable it to resist burning. Instead of burning freely when touched by a flame, wool chars. And when the flame is removed the burning stops immediately, leaving an ash which can be brushed away. Wool does not melt when burned, so it cannot stick to the skin to cause serious burns.
- Wool is readily dyed using a wide range of dyestuffs and to millions of shades.

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