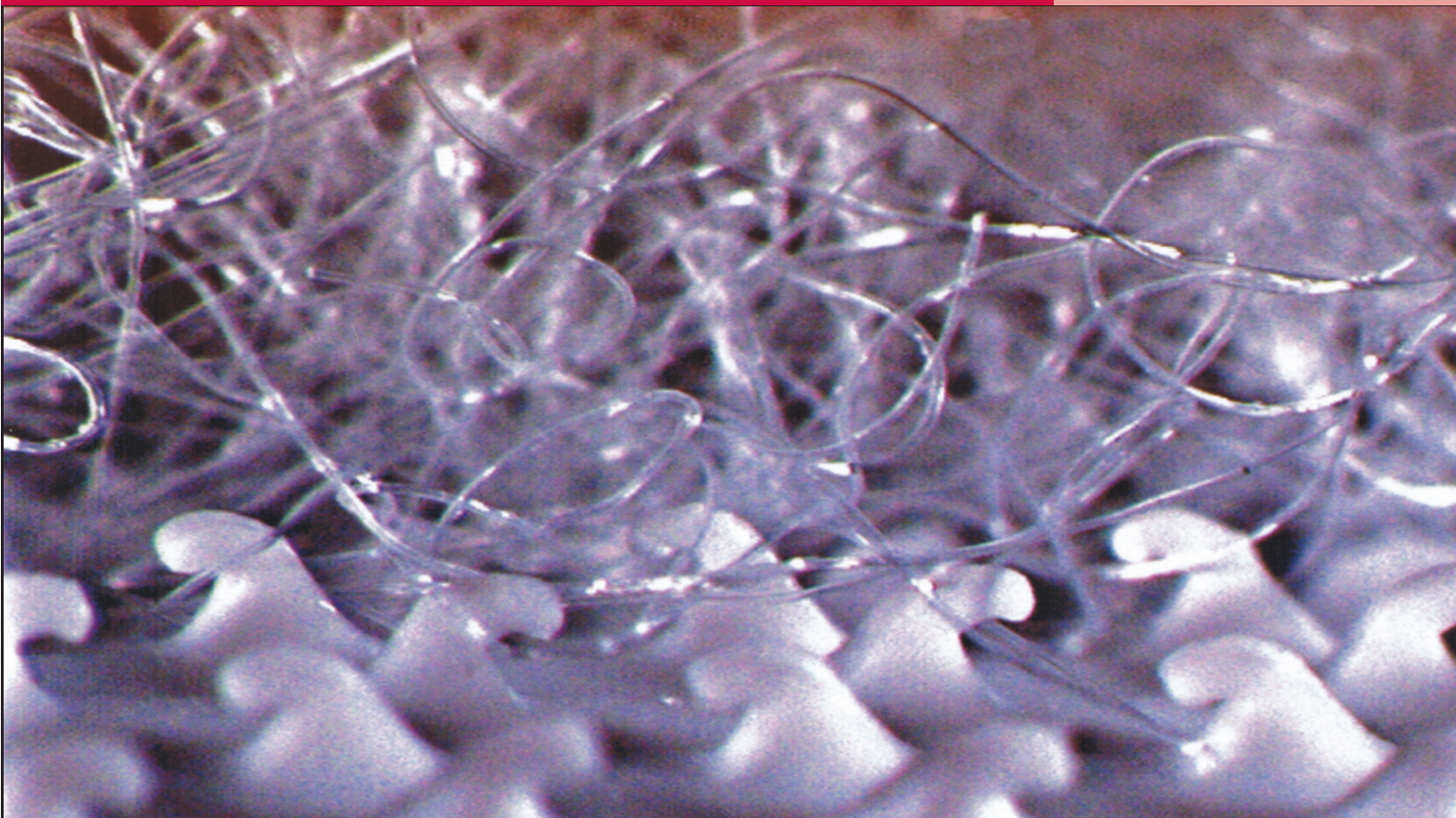




CREDIT: VELCRO USA INC

‘ZIPPERLESS ZIPPERS’

In the November/December 2009 issue of *World Footwear*, we looked at how the zipper evolved into a major fastening system that is widely used in footwear. There is another and, in many ways, even more ingenious system that has taken its place as a footwear fastener: hook and loop.

George de Mestral, an engineer in post World War II Switzerland was also a keen hunter who noticed how the seeds of burdock plants stuck stubbornly to his clothing and his dog's coat. A microscope revealed hundreds of 'hooks' that caught on anything resembling a 'loop' and allowed the plant to spread its seeds over as wide an area as possible. If he could replicate these hooks and loops, he would be able to fasten two materials reversibly in a very simple manner.

By 1948 he had invented the first hook and loop fastener but nobody would take the idea seriously. The problem lay in the use of cotton as the base material; while it worked well, it soon wore out. He turned to a relatively new material called nylon which, while its true potential was not fully realised, was nevertheless known to be extremely tough and rot-resistant, and could be produced in filaments of various thickness.

It proved the perfect choice as de Mestral found that, if sewn under hot infrared light, it produced hooks that were perfect for one side of the fastener. He then discovered that nylon thread, woven in loops and heat-treated, retained its

shape. The difficult part was cutting the loops accurately enough to be repeatedly fastened and unfastened. He finally tried using a pair of hand shears which worked perfectly and produced a practical working prototype.

A SLOW BIRTH

Mechanising the process, however, proved difficult and it was ten years before he had a commercially viable method. In the meantime, he filed for a Swiss patent which was finally granted in 1955, quickly followed by patents in Germany, Great Britain, Sweden, Italy, the Netherlands, Belgium and Canada. In 1957 he added the United States and this is where he made the biggest impact. A well known columnist, Sylvia Porter, writing in her column *'Your Money's Worth'* in August 1958, said 'A zipperless zipper has been invented that is in many ways potentially more revolutionary than was the zipper a quarter century ago'.

In the ensuing battle for distribution rights, Montreal firm Velek Ltd. gained exclusivity to market the product in Canada, South America and Japan. The all-important United States market, however, went to American Velcro, Inc. of New Hampshire and Velcro Sales of New York.

De Mestral had obtained his patents as quickly as possible in the expectation of immediate widespread demand but, in fact, quite the opposite happened and its adoption by the textile industry took time. Not everyone was convinced of

“...and it should be noted...”

The word velcro is in fact a blend of two French words, velours meaning velvet and crochet meaning hook. It is also a registered trademark in most countries. The VELCRO brand is a good example of a trademark that has become a generic in that most people refer to hook and loop fasteners as velcro.

The Velcro USA Inc. company is very protective of its name and reputation for high quality, and has taken legal action in the past against anyone making improper use of its name and brand. It in fact asks both customers and distributors to always use the word brand after a capitalised VELCRO and follow this by hook and loop fastener, touch fastener, closure or fastener.

its practicality and, at the same time, it looked rather as if it had been made from cheap fabric off-cuts.

The breakthrough came when the space agency NASA tried hook and loop fastenings on space suits. Skiers quickly saw the advantages of a one-piece suit that was easy to get in and out of and scuba divers soon followed. Seeing how the fastening kept things in astronauts' pockets while upside-down under weightlessness, led children's clothing producers to adopt it. Its useage then gradually spread in exactly the same way as had the zipper before it. The original patent ran out in 1978 and, today, hook and loop fastenings are produced under more than 300 different trademarks and in 159 countries.

A STRONG FASTENING

A good quality hook and loop fastening is in fact surprisingly strong and can have a closure bond such that a 50mm square piece is quite capable of supporting a person weighing 75kg. This strength does of course depend on how well the hooks are embedded in the loops, how much of the total surface area is involved and the type of force applied. With rigid materials, the maximum number of hooks and loops are engaged, so more force will be needed to separate them as it will be spread evenly across the total surface area.

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Where one or both pieces are flexible as in clothing, they can be pulled apart with a peeling action that applies the force to relatively few hooks at a time. This is what causes the tearing noise we associate with hook and loop fasteners. If on the other hand they are pulled with the surfaces in parallel, the force becomes as wide spread as it is with a rigid material. There are three ways to produce the strongest possible bond between two flexible surfaces:

- Use as large a piece of fastening as possible
- Ensure force is applied in *parallel (see below)
- Increasing the density of the hooks and loops

**Relatively small areas of hook and loop (as low as 10mm wide) can be used on footwear straps if the strap is folded back on itself through a slot. This effectively halves the load on the fastening by acting as a pulley that causes it to run parallel with the two surfaces as shown in figures 1 and 2.*

PROS AND CONS

Hook and loop loses very little of its fastening strength even after prolonged use provided it is kept clean and free of foreign bodies. It is also very easy to use which makes it ideal for use in childrens shoes where it can usually be managed from quite a young age, whereas shoelaces and buckles often cause difficulty. It is equally effective at the other end of life when fingers become stiffened by arthritis and for people of all ages with physical disabilities.

It does however have some drawbacks. It is prone to becoming clogged with hair, dust and fur after a few months of regular use and so needs occasional cleaning to maintain its maximum working surface. Hooks can snag on other articles of clothing if they come into contact and these may then be damaged if they are not separated very carefully. Loops can become elongated or broken after extended use, while the tearing noise made when unfastening makes it unsuitable for some footwear applications such as military where soldiers often need to be silent and undetected. Needless to say, as in most things, the better the quality of fastener, the better the performance that can be expected.

So what should one look for when choosing hook and loop fastenings? The fastening must be able to withstand the repeated peel and shear forces that will be applied in use and, this, is the only test that is normally carried out. Although various standards exist depending on where in the world the footwear is to be worn, they all simply measure the force needed to pull the two surfaces apart. The best solution, therefore, is to ensure a fastening meets the highest standard existing in the markets where the footwear is likely to be sold.

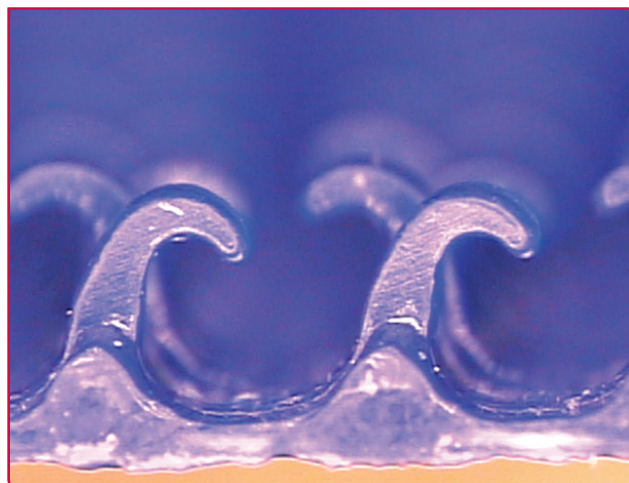
The only other factor is longevity and this will depend on the quality of the nylon and polyester that has been used in its manufacture. And, here, the best guide is price (if it is cheap there must be a reason) and brand reputation. Keeping the fastener free from being clogged by foreign bodies is up to the wearer. 🌀



Figure 1 – Shoe with strap open showing hooked tape to the left and looped tape to the right.



Figure 2 – Shoe with strap closed (tape should always be covered by the strap).



Hook and loop hooks under high magnification.

CREDIT: VELCRO USA INC