

For more than 60 years retroreflective materials have been making conditions safer for road maintenance crews, emergency services and others who work in poorly-lit and hazardous situations. More recently, those who pursue all manner of outdoor sports have been wearing luminescent clothing in greater numbers as high-visibility materials technology advances.

Seen and (hopefully) not hurt

Be it cycling, running, walking or horse riding, wherever people, and indeed animals, share roads with motor traffic they expose themselves to serious danger of physical injury or worse, especially in low-light conditions. To take just one category of road user – horse riders – accident statistics highlight the problem. They make stark and dark reading.

In the UK alone, in the year 2000 as many as 269 road traffic accidents involving horses were reported to the British Horse Society (BHS), Britain's largest equestrian charity. These resulted in the death or injury of almost 100 riders and



nearly 150 horses. To what extent poor visibility was a factor in these accidents is not recorded, but bearing in mind that most riding on roads takes place in narrow winding lanes, often with high banks and hedgerows and shaded by overhanging trees, it would be reasonable to assume that horse and rider visibility may have had some part to play.

Thankfully, the accident statistics compiled by the BHS show a year-on-year decline since 2000, but whether that's because riders are making it easier for motorists to see them in low light or because not every accident is reported is a moot point. Diane Parkinson of the society's safety department accepts that the figures are likely to be incomplete because in the UK injuries to horses don't need to be reported to the police. "Nor is there a legal requirement for riders to wear reflective gear – unfortunately."

The 60,000-member society campaigns vigorously on issues including horse and rider safety on roads and motorist awareness. It also runs more than 6,000 Riding and Road Safety tests a year and in safety leaflets urges riders to wear fluorescent/ reflective accessories at all times including, as a minimum kit, tabards for themselves and leg bands for their mounts.

Retroreflective materials, either bonded or stitched on, or woven into, sports apparel give added visibility to enthusiasts of a growing number of outdoor sports. This cyclist's visibility has been enhanced with Scotchlite.

 3M

(left) UK outdoor sports apparel manufacturer Musto uses reflective piping in many jackets in its equestrian range. The British Horse Society advises the wearing of reflective materials as part of its road and riding safety programme.

 Musto



"We would certainly like there to be a law to make the wearing of reflectors mandatory because motorists being able to see horses and riders just three seconds earlier could make all the difference," says Diane Parkinson.

With an estimated 2.4 million horse riders in the UK and the vast majority of them not British Horse Society members, there's still work to be done to get the 'be seen, be safe' message across.

Spheres and prisms

Horse riders, along with growing numbers of participants in all manner of outdoor sports, whether on the road, off road, at sea aboard yachts or even on the ski slopes, can be made more visible in low light by a choice of two main types of reflective material. By far the most commonly used is the glass micro-bead. It first appeared about 60 years ago and is probably seen every day by most people in the developed world on anything from traffic cones to hi-tech trainers.

In clothing, these beads are held by a variety of substrates. They're bonded, for example, to a variety of heat-activated adhesive films used for applications such as logos and emblems. They're also embedded in continuous laminated trims and piping, or they may be heat laminated to fabrics or backings using a heat press, roll-to-roll laminator, heat-fusing machine or RF/HF welding equipment. Alternatively, tapes of these reflective materials can simply be sewn onto other fabrics. And, more recently, converters have been producing yarns laden with reflective micro beads that are woven into fabrics.

The main alternative to glass beads was invented more than 30 years ago in the US by Reflexite Corporation. Reflexite prismatic vinyl sheeting is made into tapes up to 10cm wide that can be bonded or sewn onto garments. The company also makes emblem and logo patches in the same material. Since patents on micro-prisms ran out five years ago, other reflective materials producers have been adding their own versions to their ranges.

Whether beads or prisms, retroreflection, the principle, by which both types work, is straightforward. Rays of light from, say, a car's headlamps or a torch are returned directly towards that light source. As very little light is diffused, targets appear brighter to observers nearest the light emissions.

Being spheres, the glass beads, which are metal-backed, reflect light in a wider pattern than micro-prisms. By contrast, micro-prisms focus their reflection more intensely through a narrower viewing angle. Light strikes each of the three top surfaces of each prism and is refracted by the base surface. And for a square inch of material there are around 47,000 of these micro prisms. According to Reflexite, retroreflective efficiency is enhanced by this geometric arrangement, its economical use of surface area delivering the highest standards of reflection.

Moreover, because the surface of micro-prism



Reflexite film lends itself to 'Slaps' – high-visibility items that can be worn loosely over clothing.

 Reflexite Europe

material is flat, its reflective efficiency is less affected by rain. Micro-beads, however, present a surface of myriad tiny convex lenses whose reflectivity is diffused all the more when water droplets, also functioning as lenses, come into contact with them.

Reflexite also claims that the performance of its embedded reflective material is less likely to be affected by scuffs than exposed glass spheres.

The largest producer of reflective materials, 3M, offers both technologies in its Scotchlite range and sees advantages and disadvantages for both, according to the applications to which they are put. As one would expect, both comply with the European standard for high-visibility work wear, EN471. They also conform to EN1150, which is the standard governing visibility of clothing for non-professional use.

Caroline Walton, product manager for 3M personal safety and insulation products in the UK, told WSA: "We would always recommend glass bead technology in the first instance. This is especially relevant in the sports field as it is extremely light weight."

Indeed, compared with microprism technology, 3M claims that weight savings of up to 55 per cent are achievable. "However, somebody looking for a different aesthetic appearance may prefer our High Gloss (micro-prismatic) range," Caroline Walton added.

Certainly, fashion houses have been exploiting the aesthetics of micro-prism reflective materials. Paco Raban, for example, has been using both the brightness and colour possibilities of Reflexite (it's available in 13 colours) to dramatic effect in clothing and accessories ranges. But its adoption in sport clothing manufacturer has been broader. According to Nathalie Grynbaum, marketing manager for personal safety products with Reflexite Europe, personal safety accounts for 25

per cent of the turnover of Reflexite Corporation. "And of that 25 per cent, 10 per cent is sport," she estimates.

Most Reflexite that goes into sports attire is sold to converters who incorporate it into fabrics that are then made up into garments by sports clothing manufacturers. "It's a market complicated by the emergence of cheap sources of reflective materials, such as China," says Nathalie Grynbaum. "So it is not a market we fight for directly. We prefer to support the converters."

Companies that convert reflective materials, be they micro-bead or micro-prism, include France's JRC-Reflex. For the sports market it designs, manufactures and markets prism materials in the form of PVC rolls, tapes and piping. But as versatile as it is, micro-prism materials cannot – at least not yet – be woven, not even by innovative companies such as JRC-Reflex. The company used February's *ispo* to launch its newest innovation, a double-sided reflective tape and it will be interesting to see its future uses.

Meanwhile, what is clearly known is that one property where glass bead reflection so far has a distinct advantage over micro-prisms is that it can be woven, and that's now being exploited by JRC, among others, in its range of woven and stretch fabrics as well as tapes and piping.

Yarns used to weave such fabrics are made by spinners such as Lamè Ledal, an Italian company that produces a variety of luminescent yarns using premium-brand Scotchlite and other less expensive glass bead reflective materials. According to the company's president, Daniel Treves, such yarns "are the next step up from tapes", allowing a whole new vista of versatility.

Their uptake by weavers is growing continuously, but slowly, as there are new techniques that have to be mastered first. "Not everyone can knit or weave these items," says Daniel Treves. "Even so, Lamè Ledal luminescent yarns are now found in as many as 50 or 60 leading sports brands, including Nike and Delta socks."

The technical difficulty involved in weaving reflective yarns is confirmed by Swiss weaver Schoeller. It set out in 1995 using yarns incorporating Scotchlite with a view to developing fabrics that could be worn by athletes who wanted to continue outdoor training in safety during the winter months.

"Scotchlite is a special yarn, and to weave it in to get a durable functionality needs a special weaving technique," says the company's head of communication, Dagmar Signer. "Also, because at Schoeller it is very often used in combination with other properties such as stretch materials, fire proof fabrics and impact protection fabrics, for example, for motorcycling and workwear applications, there's a lot of technology involved." So much so, in fact, that her company will not be drawn into disclosing the secrets of its weaving techniques.

For sports applications, where certainly fire

resistance and, usually, impact protection are not prime concerns, Schoeller supplies brands such as The North Face, Louis, Rev'it, Modecka, Gericke, Dainese, Alpine Stars, Thor Racing, Daytona, Spidi and Boss. No doubt, as more weavers learn to weave with reflective materials – and as the fashion potential of such materials continues to be exploited – the list of brands offering it will grow.

Meanwhile, advances in woven reflective materials notwithstanding, there's at least one reflective materials converter that has remained steadfast in its use of glass beads bonded to fabrics and heat transfer films for a wide range of applications. For sports clothing, Italy's Autoadesivi produces Retrolux metallised micro-bead reflective fabrics.

There are four main types relevant to this market. They are RF100/WH white polyester/cotton fabric that has its retro-reflectors bonded to it by a special pigmented resin; silver grey RF500/25 designed especially for lightweight garments and sports footwear; RF500 used for sports footwear; and TT400 thermo-transfer material for tapes, trims and sports accessories. All can be silk-screen printed using vinyl-based inks.

Whatever the retroreflective technology and substrates used, and whatever their relative pros and cons, all do a vital job – protecting lives. 🌐



Swiss hi-tech weaver Schoeller has gone one step beyond bonding and sewing reflective materials. By a closely-guarded secret process it weaves Scotchlite yarns into fabrics, as seen in this Hugo Boss jacket.

 Schoeller