

The hard hat symbol has become a recognised sign for safety in factories and on construction sites around the globe. But accidents can happen at any time and in a wide variety of situations—both in and outside the workplace—and it's not only our heads that need protection. Whilst we expose our feet to a multitude of risks, the shoe industry has been thinking on its feet and has developed footwear to protect us whether at work or at play.

Hard hats for the feet

The term 'protective footwear' covers a broad spectrum of functions including abrasion resistant upper materials for mountaineering rescue crews, non-slip soling for fishermen, Nomex fire retardant materials for fire fighters, electrostatic dissipative (ESD) soling in clean rooms, land mine blast protection for soldiers — or even reflective safety trim for night runners. It is therefore crucial that consumers choose the appropriate form of protection that fits their work or play activities, to prevent their feet from being crushed, fractured, pierced or burnt. Here are some of the latest protective products being introduced onto the market.

Playing safely

Hikers, ice climbers, mountaineers, trekkers, snowboarders, motor cyclists and emergency crews have trusted the abrasion, tear and rip proof Kepron fabrics produced by Schoeller, Switzerland, for many years. These fabrics contain Kevlar fibres and are used for shoes and boots which have to meet the highest safety requirements in terms of robustness, durability and comfort. The different footwear qualities in this product range and the similarly abrasion-proof 'Dynatec' group also offer further performance features such as breathability, good air permeability, full-surface reflection, comfortable stretch, and a high standard of fire and cut proofing. An additional significant criterion is the weight factor, which ranges from the extremely light to the compact weight class. Lighter fabrics with good stability and safety features are increasingly being used in the work place as well as for running, sailing and tennis shoes to reduce injuries.

Whilst these fabrics have been on the market for a number of years, Schoeller has not stood still and it has further enhanced the level of functionality of its fabrics by adding new finishing technologies. NanoSphere technology offers a high level of water and stain protection, whilst 3XDry provides active



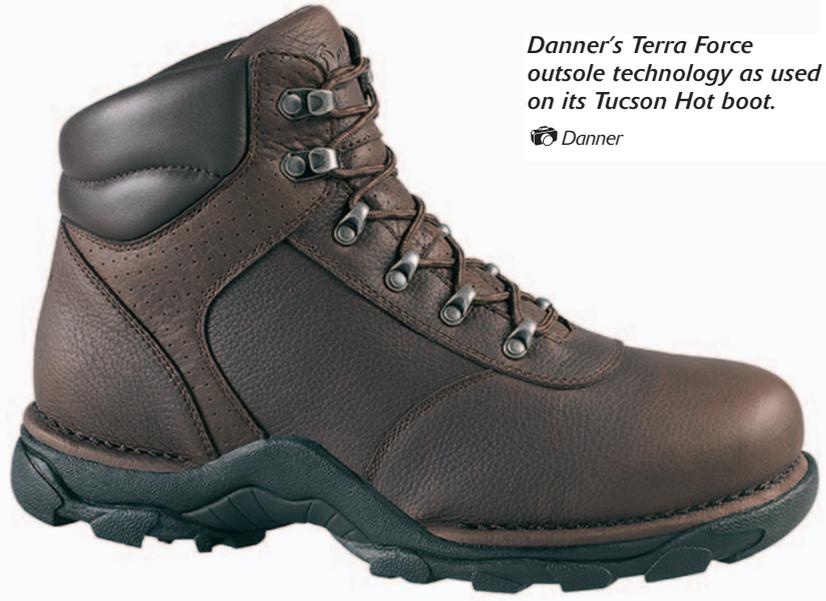
moisture management. As a result of its antimicrobial protection, the new ActiveSilver finish is said to “bring day-long freshness”; and ‘Active’ temperature regulation is achieved through phase-change materials. These technologies are now also combined with Schoeller’s ‘c-change’ membrane technology, which opens and closes depending on temperature and moisture levels. By enhancing its technology, Schoeller provides footwear fabrics that are not only wind and waterproof but are also said to provide a ‘feel good’ climate and these have proved popular as the company supplies performance upper materials to big name brands including Bestard, Sportiva, Timberland, Scarpa, SpringBoost, Atomic Amer, Raichle, Garmont, Murphy & Nye and Kolon (Activ).

Footwear brand Danner USA developed its own innovative technology to offer long distance hikers relief from hot climates with its new Hot technology. The Tucson Hot is constructed with materials and technology designed to protect the feet in warm weather conditions, with a Coolmax lining that wicks away moisture to keep feet dry and comfortable. For spring 2007 Danner has incorporated this technology into several models including Terra Force, Terra Force X and Camohide, which include branded materials such as Coolmax, Gore-Tex, Vibram and Thinsulate Ultra Insulation to offer a boot that is built for outdoor work or sport in extreme conditions. Danner also incorporates the popular branded patterns of Realtree and Mossy Oak.

Some extreme sports require an even higher level of protection when it comes to heat. The safety footwear worn for serious motor car racing (and at speeds in excess of 200mph [322kph] who is not serious?) needs to provide more than temperature regulation, it must also offer protection from heat and flames, in case of an accident. Simpson and Pilot are well known producers in this field and both use DuPont’s Nomex lining material to ensure the correct level of protection in these circumstances. Nomex is an inherently flame-resistant aramid fibre that will not melt, drip or support combustion in the air. Its flame resistance is permanent, which means it cannot be washed out or worn away.

On the defensive

Danner is probably best known as a producer of military safety boots for the military services, which can include various categories from underfoot landmine protection to mountain cold weather boots, such as those specially designed by the company for the United States Marine Corps. As with apparel, US military grade boots and shoes must be produced domestically to US Department of Defense (DoD) Index of Specifications and Standards. A typical example



Danner’s Terra Force outsole technology as used on its Tucson Hot boot.

 Danner

of these is Danner’s Hot Weather Combat Boots which come in two types—one for wet conditions and one for dry environments—both of which are covered by 36 full pages of materials specifications and construction details.

All boots made under DoD contracts are held to strict military specifications adhering to ASTM, ISO and SATRA standards and perhaps the most challenging specialised military safety footwear is that produced to minimise injuries caused by anti-personnel landmines. There are two types of footwear to protect against mines, depending on the type of mine. Fragmentation mines scatter metal fragments through the air, cutting into anything in their path. Protection from this type of mine takes the form of Kevlar and ballistic nylon mesh reinforced upper materials to cover the top of the foot and lower leg. Protection from an underfoot blast mine demands more complex footwear construction methods. To deal with this type of mine Wellco has developed specialised protective anti-personnel boots with deep outsole cleats and an extra thick midsole wedge in the sole that acts as a large cushion to spread the shock impact over a greater surface area. Another anti-blast footwear device comes in the form of a strap-on metal platform used to elevate the primary footwear. Produced by Med-Eng Systems, the ‘Spider Boot’, as it has become nicknamed, exploits a unique design to distance the foot from the source of the blast, allowing the energy and fragments produced by the blast to be dispersed and deflected away from the foot.

Protecting the workforce

According to the National Safety Council in the USA, the number of reported foot-related workplace injuries exceeds 180,000 per year—that’s some 450 cases a day. As a result the US industrial demand for safety shoes and boots is significant and the market for rubber or plastic boots, and foot and leg guards is holding steady

at just over \$1 billion, with approximately \$80 per employee spent on foot protection per year.

There are two major categories of work-related foot injuries. The first includes punctures, crushing, sprains and lacerations; the second involves injuries resulting from slips, trips and falls. Added together, the two categories represent nearly 25% of all disabling work-related injuries. In addition, there is a wide range of foot problems associated with workplace conditions, including calluses, ingrown toenails, plantar fasciitis and plain old tired, aching feet. While it is difficult to measure, fatigue can be a contributor to accidents, hence the trend towards lightweight, more comfortable footwear. The aim of reducing weight and increasing comfort is to ensure that workers tire less during the long workday which will, hopefully, reduce the number of fatigue-related accidents. In response to this increased demand for comfort in work footwear, LaCrosse recently developed its Quad Comfort system to provide extra protection, support and comfort on the work site with a four-layer cushioning system. It includes an EVA footbed for arch support; a second layer of EVA foam for added support; a Quad Core layer, which is another layer of EVA covering the insole board for lateral support; and cut out zones to offload and add extra cushioning in notorious pressure areas in the heel and forefoot.

The comfort of protective footwear has also become more important as the customer-base has changed. Whilst safety footwear is still a critical tool for those working in industries such as mining and construction, law enforcement and fire fighting, manufacturing jobs have declined in the USA over the past few years. At the same time the service sector in the USA continues to grow and these workers also require high performance and protective footwear. Companies such as Wolverine, Red Wing and Lehigh that specialise in work safety footwear have responded to this change in requirements and Red Wing alone now offers more than 180 styles of boots and shoes—ranging from the stereotypical nubuck six inch, steel toe construction boot to the non-slip athletic-styled look with disguised non-metallic safety toecap.

A capped market

Safety toecaps are probably the first thing to spring to mind for many when asked to name an item connected to protective footwear. Although they may be considered a 'simple' safety feature in protective footwear, even this traditional safety feature has been redesigned and improved. One Australian company, Footwear Industries Pty. Ltd., is making inroads with what is claimed to be the first non-metallic and clear safety toecap in the world, known as



Hi-PA, or High Impact Polymer Alloy, that has passed three major international impact tests: the Australian and New Zealand Standards AS/NZS 2210.3 Class 1, European EN345 Class 1 and USA ANSI Z41 Class 1. In fact, whilst tests have shown that no steel toecap can receive two consecutive 200 joule impacts and still pass the impact test standard, the Hi-PA toecap has been shown to retain its integrity after five consecutive impacts without failing the minimum clearance. In addition, the Hi-PA toecap was subjected to a number of additional tests that steel is not required to undertake, such as immersion in various solutions including sulphuric acid, sodium hydroxide and isooctane for 24 hours prior to impact testing. It is also said to be completely transparent.

Another recent development in safety toecaps has been introduced by the Esjot Group, a division of Texon International Group Ltd. Using a new technology called Liquid Forged Aluminium Alloy, the new toecaps—that are interchangeable with steel caps—offer reduced weight, cost savings and are comparable in performance with hot-forging. The new toecaps conform to the EN 12568 Standard and absorb more energy on impact than steel approved to 200 joules caps. Like the Australian Hi-PA safety toecap, the Esjot cap is non-corrosive and also non-magnetic, making it well-suited for ESD safety footwear.

Safety footwear may not be considered to be at the 'cutting edge' of technology. But, in its many forms, it is both innovative and progressive and plays an important role in our lives. Like the airbags in our cars and trucks, we may not really notice that they're there, but we'd miss them if they weren't. Fortunately, while we may take safety footwear for granted, the brands that design and develop it continue to innovate and make improvements to ensure that we are protected in the workplace, on the battlefield, in the home, or simply at play. 

Quad Comfort, developed by LaCrosse is essentially four layers of extra cushioning as employed in the Meridian work boot, which also features a T6 alloy toe.

 LaCrosse Footwear