

Standards for safety footwear

SATRA's deputy chief executive, Richard Turner, reports on technical innovation and changes to European and international standards



SATRA: hosting CEN committee meetings

Although it may not appear to be at the cutting edge, safety and protective footwear has seen as much, if not more, development over the last five years as any other type or style of footwear. Design continues to evolve and technical innovation is ongoing and progressive. It is the latter we will concentrate on here.

There are two main drivers for the technical advancement of safety and protective footwear:

- The move of shoe production from West to East
- The recent changes to the European and now international standards for such products

SATRA has played a significant part on both fronts. As the leading EU Notified Body for safety footwear (under the PPE Directive) it has a large customer base in south east China. As far as standards-making is concerned, several of its staff make a contribution, including the author as chairman of both the CEN committee TC161 and its ISO sister group TC94 SC3 (CEN is the committee for European Normalisation; ISO is the International Standards Organisation).

Modern methods of construction

A significant proportion of safety footwear made in China uses some form of forced lasting as opposed to flat lasting. Sewn-in sock, Strobel and string lasting are all common methods and bring economies in production costs. This is especially so where the bottoming process is either injection or reaction moulding, or direct vulcanisation (DDV) rather than stuck-on moulded sole units.

These lasting techniques open up the possibility of using different materials within the overall bottom construction to impart safety features. Chief among these is penetration resistance without the need for a metal plate or insert. Although metal plates work well, textile materials (sewn-in, by say, the Strobel process) offer more flexible sole/bottom assemblies and the advantage that shoes containing them will not trigger metal detectors or similar devices if in use.

However, such textile anti-penetration materials have not been universally accepted, and it has been pointed out that since they are stitched-in, they cannot be truly penetration resistant. This said, they do allow sole units to pass the requirements in EN ISO 20345 (a penetration force of at least 1100N to push a truncated probe through the bottom assembly using the method in EN ISO 20344). There is little or no evidence to suggest that this level is any less safe than for the corresponding metal insert and, indeed, some textiles give higher penetration values (well over 2000N) than might be expected from the thinner types of plate.

Attempts have been made to show that if the tests are repeated using a finer, smaller diameter probe, then the result is below 1100N. This has been confirmed by work at SATRA. However, this modified test has no validity for EC type approval against EN ISO 20345 (6 or 7) and, indeed, steel plates also give reduced penetration loads with a narrower probe. It should be noted that with the sewn-in or Strobel stitched construction there will be complete coverage against penetration over the whole of the underfoot area. This is something that is not guaranteed with a metal plate (the standard allows gaps and

provides for only about 80-85% coverage as the minimum requirement).

In another move away from metallic components, more use is being made of non-metallic or plastic toe caps. There are also some lightweight aluminium caps on the market and steel caps that have been perforated.

Plastic caps are available that perform well under a 200 joule impact, retaining the necessary clearance to satisfy the requirements in EN ISO 20345. However, it is important to remember that, unlike a steel cap, one made from plastic will not normally exhibit permanent deformation after impact (i.e. it will spring back into shape), promoting a false sense of security for the wearer. The 20345 standard does in fact have a requirement for the cracking of plastic caps on impact, but it could be argued that it would benefit from being more demanding with respect to any cracking seen—or perhaps by calling for a second impact.

Plastic caps help to provide a lighter weight boot and will not interfere with metal detectors and similar security alarms. SATRA is currently looking into all the pros and cons of these components as they clearly have a place in modern safety footwear production.

Developments within European and ISO standards (including the American position which continues to differ from that in EN and ISO)

The 2004 revision of EN ISO 20344 -5 -6 -7, to be fully implemented across the 25 nation states within the EU by August 2005, contains a series of small but important changes. One that has made an impact is the lowering of the pH value for the water extract of both outer and lining leather from 3.5 to 3.2. But the difference value for all readings below 4 does remain the same and this, of course, provides the safeguard against leathers that may be too acidic in use. This change (advocated by SATRA) has allowed greater use of leathers in the 1.8 to 2.4 mm or even 2.6 mm thickness range that have been tanned to be extremely water resistant. Typical examples would be leathers based on heavier North American wet blue stock.

The process of amending the 2004 standards has already started. Several complementary new documents have either been published, such as EN ISO 17249 for chainsaw resistant footwear or are ready to go to a vote as ENs (e.g. a three-part series on chemical resistant footwear and a European standard for firefighters' footwear).

In addition, in March 2004, CEN TC161 published EN13287, a method for assessing the slip resistance of soles on safety shoes and boots. This test draws heavily on the well known SATRA TM144:2004 and test machine STM603, though there are some subtle differences such as the use of a ceramic tile in EN 13287 with water containing sodium lauryl sulphate as the lubricant (TM144 uses a quarry clay tile as standard).

The establishment of this method as a European norm has to be seen as a major achievement and fully endorses the line SATRA has taken on slip resistance testing for nearly thirty years. The next step, the adoption within EN ISO20345-6-7 of performance levels for slip, will be no less important or any less difficult to achieve. At its meeting in May 2005, TC161 agreed to begin the process of ratifying values on a choice of surfaces (the ceramic tile plus steel with glycerine contaminant) and this process should be completed before the end of 2006.

Also at its May 2005 series of meetings, TC161 and its three Working Groups decided that for chainsaw resistant footwear, the rule on mandatory oil resistance of the sole should be relaxed to aid slip under sub-zero conditions. It also decided to work on a method to assess sole slip on ice as the two issues are clearly connected. Removing the mandatory requirement for oil resistance will also allow the use of more innovative sole compounds and it will be interesting to see where this leads. It may, in time, result in the oil resistance requirement becoming optional for all EN ISO 20345 type footwear.

Developments are under way in TC161, to add additional tests for the flex cracking of soles and whole shoe water resistance. For some time now there have been concerns that the Bennewart whole sole flex test is overly severe. A recent study confirmed that this was indeed the case, albeit with a limited number of soles. The Bata Belt test, on the other hand, not only gave flex crack results comparable with wear experience, but also proved more consistent in the inter-lab trials run by SATRA. A modified version of the Nikwax whole shoe water resistance test looks promising as a possible replacement for the trough test for whole shoe water resistance and TC161 saw a demonstration at its recent meeting in Kettering of a machine designed for heavy duty footwear.

Some time ago, ISO decided to pursue a different route to CEN with respect to its standard for firefighters' footwear, at least in part. Both standards are approaching the final draft stage and, as is to be expected, both lean heavily on EN ISO 20345, 6 and 7 for many of the basic requirements. However, the ISO draft differs from the CEN document in that it contains what appear to be some overly severe heat and flame tests and requirements.



Slip testing of safety footwear

For example, ISO has added an oven test, even though it is clear that the inside of the boot could well reach temperatures above those tolerable by the human foot (about 42-45°C). Recent work also suggests that the ISO flame test being proposed has the potential to fail product currently in successful use with several UK fire brigades. The CEN tests are being modified to ensure that the results here align with real wear experience. It seems likely that this will be achieved.

Whereas CEN standards (ENs) are mandatory within the ➤

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Bata Belt flexing safety soles

EU, ISO documents are not, unless of course they are dual numbered as EN ISO. It seems likely, therefore, that the EN standard will be used to CE Mark (EC Type approve) firefighters' footwear within the 25 member states of the EU, leaving the rest of the world to decide whether or not to follow suit or use the ISO standard.

A similar situation exists with North American standards for

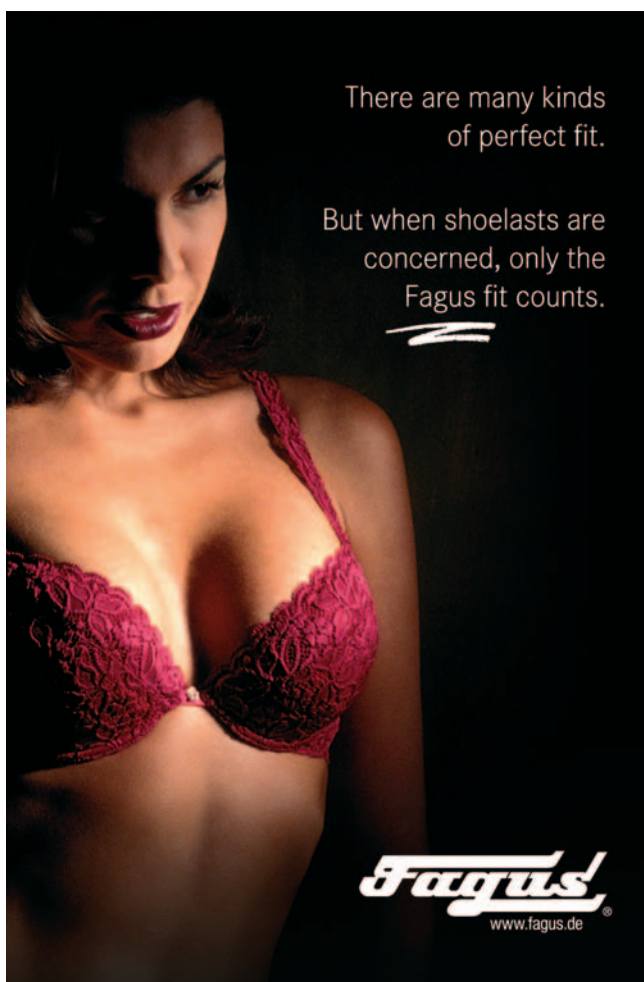
safety footwear. The Canadian (CSA) version has suffered from some poorly handled recent revisions and is not widely used outside of Canada, although the country itself seems reluctant to adopt the (EN) ISO documents.

In the USA, for many years ANSI (American National Standards Institute) looked after footwear standards and published these as ANSI Z-41. ANSI recently handed Z-41 over to ASTM, which has modified the text slightly and recently re-published with ASTM references. An ideal opportunity to adopt ISO standards (EN ISO 20344, etc) has therefore been missed. On the grounds of compliance testing cost savings alone, such an amalgamation has to be seen as beneficial to the global industry.

TC161 and its Working Groups will continue to develop better standards that fully reflect the global market. SATRA will play an important part in this and will also carry on with its own extensive safety footwear research programme, including further innovations such as a safety footwear comfort award. Few, if any, of the other EU Notified Bodies can match this research effort and SATRA leads the way in terms of its capability to carry out all the tests in EN ISO 20344 plus EN 13287. It is also the UK CEN Keymark holder for safety footwear and provides the chair for the BSI shadow committee (PH/1) to TC161. 

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