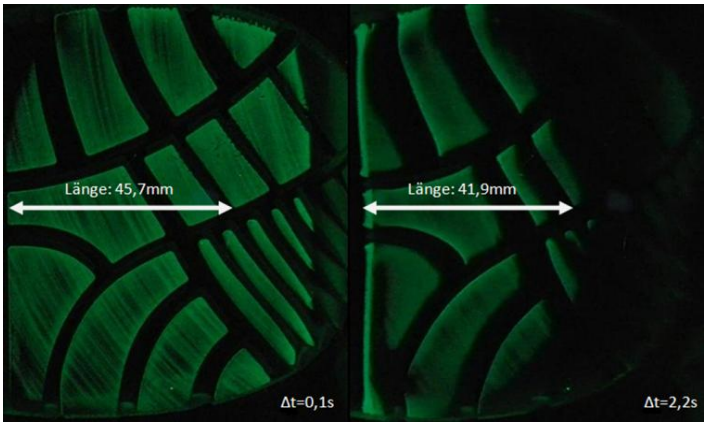
Optimum Slip Resistance?

Some 280,000 slip, trip, and fall accidents were recorded by occupational insurance associations in Germany during 2010. The greatest risk factor for such accidents: Inadequate slip resistance of footwear. In order to reduce the considerable number of accidents and to better protect both individual persons as well as the economy, PFI is currently working on a research project entitled "Sole Design Guidelines with Regard to Optimised Slip Resistance and Breaking Strength". The goal is to develop a method of optimising sole design in the area of slip resistance well before production of any prototypes takes place.

In 2010 about 280,000 slip, trip, and fall (STF) accidents were reported in trade and industry in Germany. This means that over 1000 such accidents occur on each working day. Approximately 37 percent of these STF accidents are so serious that they restrict a person's ability to work or lead to payment of an invalidity retirement pension. The German occupational insurance associations estimate that the annual cost of rehabilitation measures and compensation necessitated by slips, trips, and falls to be about € 330m. And the cost of work stoppages due to STF accidents is even higher: a total of € 8bn has been quoted for the German economy[1].

The slip resistance of footwear is determined largely by the sole. However, the design of slip-resistant soles is largely shaped by experience; generally accessible guidelines thus hardly exist for the design of slip-resistant soles. The research project "Sole Design Guidelines with Regard to Optimised Slip Resistance and Breaking Strength" aims to fill precisely this gap by identifying and evaluating factors influencing slip resistance and combining them to produce a set of readily applicable rules. The focus of attention is on shoe-floor systems; the floor surface is presumed to be non-distorting and the shoe is presumed to have a flat heel. The information gained is particularly valuable in the safety shoe sector, but can also be applied to other areas.



In order to identify the parameters affecting slip resistance, PFI has developed, among other devices, an instrument for measuring the area of contact and for visualising the behaviour of the sole during a sliding motion. Figure 1 shows a sole observed in such a way during a sliding motion.

Figure 1: Contact surface image of a shoe at the start and in the course of a sliding motion when subjected to a normal force of 500 N. The load on the front edge of the tread and distortion of the raised sections of the tread are clearly visible.

[1] Standke W., Statistik – Makrodaten, Arbeits- und Schülerunfälle: Arbeitsunfallgeschehen 2010, DGUV Deutsche Gesetzliche Unfallversicherung, 2nd Edition, July 2012

This provides information about the behaviour of the contact surface over the duration of the sliding motion, the length of the edges under load, and the contraction of the tread structure.

The information gained is then correlated with material data such as hardness and composition and the values obtained during slip resistance testing according to DIN EN ISO 13287 (see Figure 2).

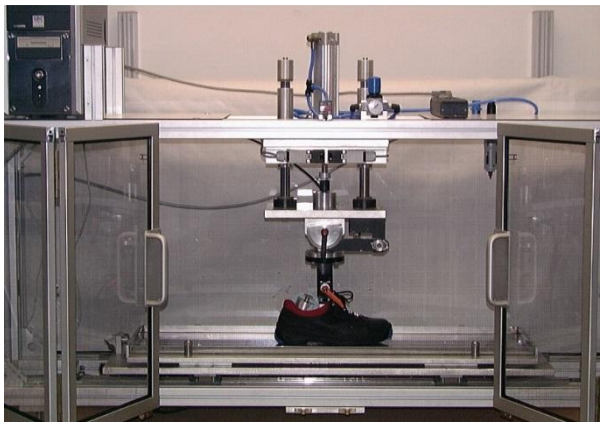


Figure 2: Shoe during a slip resistance test according to DIN EN ISO 13287

When the project comes to an end, the results will be summarised as a catalogue of recommendations for raising slip resistance which will provide support for shoe designers early on in the design process. The objective is to offer recommendations with regard to the contact area, the edge length, the tread depth, and the width of the tread channels for a given sole design. The recommendations will be supplemented by information relating to sole breakage resistance with the goal of reducing crack- and fracture-promoting structural features such as cross grooves in the area of the bending zone of the shoe.

This set of recommendations will help to reduce expensive trial and error work in design, prototyping, and testing of shoe and sole designs, which will speed up the development of new designs and reduce costs.

In a second step, the catalogue of recommendations could be supplemented by a software package which is able to recognise the shapes of the sole tread elements and to assess them according to the criteria of the slip and rupture resistance recommendations listed in the catalogue.

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Further information

Dipl.-Ing. Fabian Homberg
Tel.: +49 (0)6331/2490921,
E-Mail: fabian.homberg@pfi-germany.de