

# The effect of oil resistance of footwear outsoles on slip resistance characteristics in winter conditions

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**Introduction.** In European standards EN ISO 20345:2004 and EN ISO 20346:2004 oil resistance of outsoles is defined as an obligatory requirement for professional footwear.

- Non-oil resistant materials, such as TR or natural rubber, have been considered to be more slip resistant in winter conditions than oil resistant materials.
- Based on this requirement non-oil resistant outsole materials can not be used as outsoles in professional footwear.

**The aim of this study** was to find out whether there is a major difference between slip resistance characteristics of oil resistant professional footwear and non-oil resistant footwear in winter conditions.

**Materials.** The following commonly used footwear types and outsole materials (23 in total) were selected:

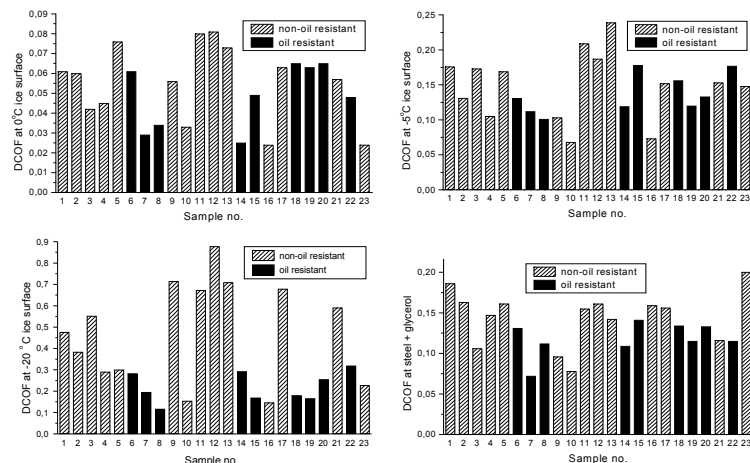
- Oil resistant safety footwear with PU, TPU and NBR outsoles,
- Separate outsole samples made of NR, TR, SBR, NBR, PU and EVA,
- Ordinary winter shoes with TR outsoles,
- Rubber boots,
- Winter and leisure time shoes, the outsoles of which were made of various rubber compounds.

**DCOF measurements.** The slip resistance *i.e.* Dynamic coefficient of friction (DCOF), of the outsole samples was measured by using the Portable Slip Simulator of FIOH. The measurements were performed in a climatic chamber.

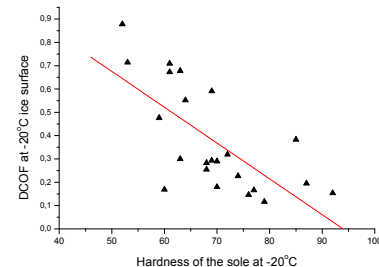


- Smooth ice at different temperatures: 0°C, -5°C and -20°C was used as the testing surface,
- On wet ice of 0°C, there was a thin layer of approximately 1-2 mm of water on the icy surface,

- Prior to the measurements, the samples were stored at measurement temperature in the climatic chamber for 8 hours,
- For comparison, DCOF measurements were also performed at room temperature (20°C), using a steel surface with glycerol as a lubricant.



**Hardness measurements.** Hardness of outsoles was measured both at room temperature (20°C) and at -20°C. Change in hardness due to cold was found. Oil resistant footwear hardened more in cold than non-oil resistant ones. Difference was found to be statistically highly significant.



**Conclusions.** The European and ISO standards with their obligatory requirement of oil resistant outsoles seem to restrict the use of more slip resistant outsole materials especially in icy conditions.

It is recommended that the CEN and ISO standards for professional footwear should be altered to make oil resistance an additional requirement, so that more slip resistant outsole materials could be used on surfaces, where the accident risk from slipping outweighs the possible hazards caused by fuel oil.

**Relevance to preparation of standards/standardisation.**

The obligatory requirement of the oil resistance of outsole was changed optional in standard EN ISO 17249:2004 - Safety footwear with resistance to chain saw cutting.

The change was confirmed in amendment EN ISO 17249:2004/A1:2007. This gives better possibilities to develop more slip resistant footwear for forestry workers in winter conditions.

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**Reference.** Aschan C, Hirvonen M, Rajamäki E, Mannelin T. Slip resistance of oil resistant and non-oil resistant footwear outsoles in winter conditions. *Safety Science* 2005;43:373-89.



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