

## Development of 3D printed composite elements for better stab protection

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### ABSTRACT

Violations against public service employees have been increasing in number and intensity for years. In 2018, 74.000 attacks on police officers were registered in Germany [1]. Due to the dangerous situation, knife attacks are recorded separately in the police crime statistics of the Federal Criminal Police Office since January 2020 [2].

This work presents new development of the new generation of stab protection equipment. Here investigations were carried out with regard to material selection, geometry design and the influence of the textile layer. For this purpose, test samples were developed using 3D CAD software and printed with a special FDM technique (fused deposition modeling). Figure 2-1 shows a curved sample consisting of matrix and incorporated fiber reinforcements (blue). The resulting fiber composites were tested in accordance with the VPAM (Association of Testing Institutes for Attack Resistant Materials and Structures<sup>1</sup>) - KDIW 2004 standard. The samples were used on a special drop stand of the ITM (Institute of Textile Machinery and High Performance Material Technology) with a high-speed camera. Its recordings provide additional insight into the stab protection behaviour of the 3D printed samples upon impact of the blade, see Figure 2-2. A number of various parameters play a significant factor in achieving the desired protection class K1 in accordance with VPAM.

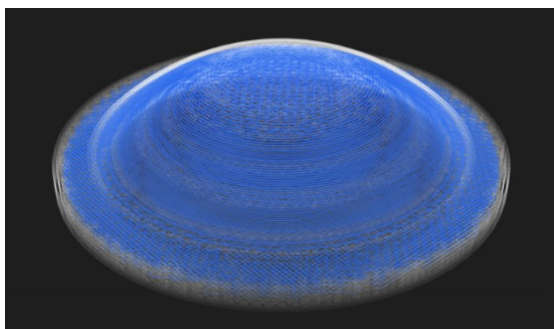


Figure 2-1: Slicer view of the molded specimen with fiber reinforcement layers in blue.



Figure 2-2: High-speed image of a round sample

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<sup>1</sup> Vereinigung der Prüfstellen für angriffshemmende Materialien und Konstruktionen

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