Understanding Clothing Insulation with Help of Virtual Tools - Case Study of Fire Fighter Clothing

Lena PARVUS [1,2], Agnes PSIKUTA *[1]
[1] Empa - Swiss Federal Laboratories for Material Science and Technology
Laboratory for Biomimetic Membranes and Textiles, St. Gallen, Switzerland;
[2] Reutlingen University, Reutlingen, Germany

Abstract

Both the physical properties of the fabric materials used in clothing and the effective design of the clothing, primarily in terms of the air gap thickness, restrict the transmission of the thermal energy from the heat source to the firefighter's body. The air gap distribution over the body in real deployment conditions of firefighters will vary, The knowledge of local clothing properties in real-life exposure provides a true protection mapping and gives design inputs to improve the local protective properties of fire-fighters' clothing. To explore the distribution of air layers in complex multi-panel and multi-layer firefighter clothing we used the CLO3D software to visualize the air layer distribution across the clothing thickness and related it to the thermal resistance property. One of the findings suggested that the stiffer the outershell of the firefighter jacket, the more balanced the distribution of air layers between inner layers (Fig 1, left) leading to higher total thermal insulation (Fig1, right). The devised methodology has been systematically validated using 3D-scanned data for multilayer garments with different level of complexity. The findings of this study are being used for optimization of thermal properties of firefighter protective clothing.

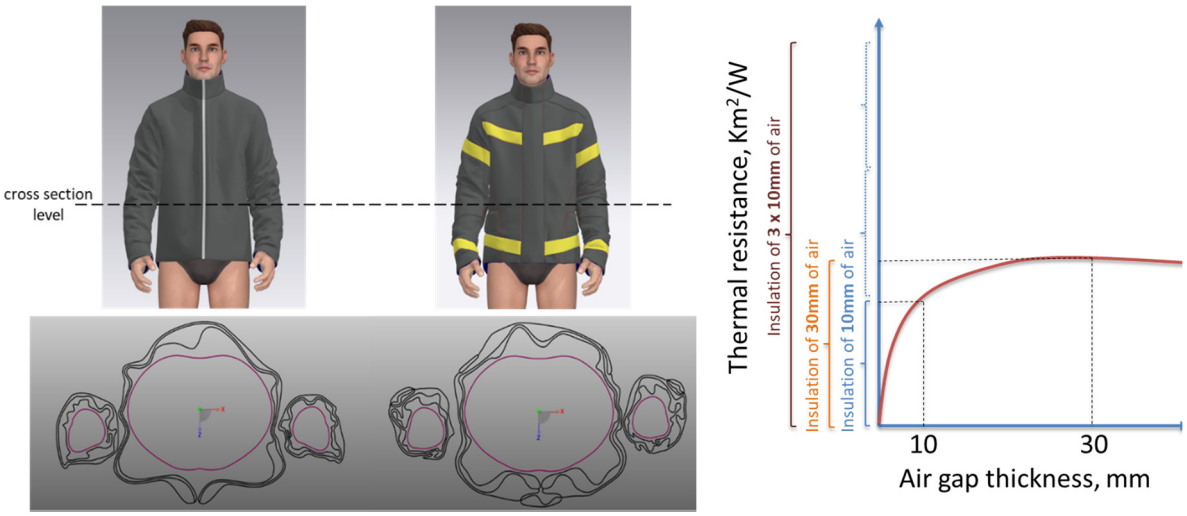

Figure 1. Visualisations and cross-sections of plain jacket and jacket with all construction details consisting of 3-layer fabric assembly (left), and principle of propagation of thermal insulation across enclosed air layers in clothing (right).

* Presenting author