Development of an instrument for measuring the thermal protective performance of fabrics at different orientations

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Abstract: This paper presents the design and development of a novel instrument for assessing the thermal protective performance (TPP) of single or multilayer fabric. The heat transfer between two surfaces depends on different convective heat transfer which is affected by buoyancy force, thermal stratification, etc. [1], [2]. In contrast to the traditional techniques, this device can evaluate TPP in various orientations, giving rise to a thorough comprehension of material behavior in a range of temperature exposure conditions.

To develop the instrument the components described in existing standards such as ASTM F 2703, and ASTM F2700 were used. The convective and radiative heat sources, sample size, heat exposure, and evaluation of second-degree burn time have been used according to the standards along with other novel features such as change of orientation, change of air gaps, etc.

The developed equipment was used to conduct experimental investigations, which demonstrated significant differences in TPP between the tested materials' various orientations. These results highlight the significance of taking orientation-dependent aspects into account when evaluating the effectiveness of thermal protection. Furthermore, the findings provide insight into possible outcomes for selecting and designing materials optimally for applications needing thermal protection and insulation.

To improve thermal protection performance assessment and ensure optimal safety in a variety of thermal environments, researchers and industry professionals can benefit greatly from the developed instrument, which marks a significant advancement in the fields of material science and protective clothing development.

Keywords: *Thermal protective performance, firefighter suit, multilayer thermal protective clothing*

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