Enhancing fire protection for helicopter crews by selecting the appropriate fabric for flying clothing

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ABSTRACT

Military helicopter aircrew continue to be exposed to the risk of in flight and post crash fires. The burns received in these incidents cause significant morbidity and often lifelong disability to the survivors. Clothing systems offering some fire protection are provided but they impose a physical and thermal burden on their users. Fabrics are constantly improving and alternatives providing better protection, comfort and utility may be available.

This study examines the fabrics available for protection to identify the optimum material that meets the military requirements whilst providing an acceptable level of protection from fire.

19 fabrics were examined against a range of flying clothing requirements and subjected to vertical flame testing. UK military helicopter flying clothing was then manufactured from the most suitable fabrics and tested using an instrumented thermal mannequin. 7 clothing ensembles were evaluated with a 4 second flame exposure of 84 kW/m². The percentage of mannequin receiving burn injuries was then recorded. Performance of ensembles was judged on their abilities to prevent 2nd and 3rd degree burn injuries.

Vertical flame testing discriminated flame retardant from non flame retardant fabrics but consistently failed to predict performance of complete ensembles. Mannequin testing identified two major performance characteristics, namely fabric shrinkage and after-flame. Fabric shrinkage was the strongest predictor of ability to prevent burn injury with degradation in performance as fabric shrinkage increased. After-flame occurred with many fabrics and the intensity of flame varied. The most intense after-flame resulted in a worsening of burn injury but, in general, after-flame was a poor indication of protective performance.

A tolerable burn injury target was set but no fabrics achieved this level. PBI Gold provided the best flame protection but Defender M was, overall, the most suitable military helicopter uniform fabric when other key requirements were taken into account.