NUMERICAL MODELLING OF BLAST EVENTS TO DESIGN AN INNOVATIVE BLAST RESISTANT TEXTILE LUGGAGE CONTAINER

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Abstract

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1. Introduction

This paper deals with the activities of numerical simulations and validation for the development of a textile container for the blast protection of cargo holds. The activities are carried out within the FLY-BAG Research Project “Blastworthy textile-based luggage for aviation safety”, co-funded by the European Commission, 7 FP, under the Transport Aerostructures research area.

About 75% of the aircrafts in service are narrow-body aircrafts, and more than 70% of bombing attempts have been against these aircrafts. The risk that a small quantity of an explosive, below the threshold of the detection instruments, could get undetected cannot be discarded, and the introduction of countermeasures to reduce the effects of on-board explosions should be considered, especially for narrow-body aircrafts. Existing Hardened Unit Load Devices (HULD) have been developed to reduce the effects of on-board explosions, but they have some disadvantages which prevent their wider utilization: they are heavier and much more expensive than standard luggage containers and, notably, applicable only to wide-body aircrafts. The research and development of hardened containers for narrow-body aircraft are lagging behind the work on containers for wide-body aircraft. Limited research has been done on container role as part of a total architecture for aviation security.

Explosion-containment strategies and development of a new concept of ULD (Unit Load Device) for narrow-body supported by numerical simulations is the aim of the study presented. In particular, the work points out the importance of the numerical modelling approach in order to virtually reproduce the blast tests carried out for the characterization of materials used for the innovative blastworthy luggage container. All experimental tests have been simulated and validated in order to predict materials behaviour and to perform sensitivity analysis. Numerical simulations are carried out to perform sensitivity studies and to investigate the effect of the test parameters variability, such as bomb placement, luggage filling ratio.

Full scale blast tests are then performed for the validation of the numerical simulations and for the demonstration of the Fly-bag concept behavouir. All activities have been focussed on the containment of blast waves and on the reduction of the aircraft structure damage.