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NEW DESIGN FOR DEMISE TECHNOLOGY CONCEPTS FOR STRUCTURAL JOINING TECHNOLOGIES

Abstract

The recently introduced discipline of Design for Demise aims to promote the atmospheric demise of a spacecraft, and its respective components. The objective is to reduce the casualty risk on the ground. Technical solutions exist at different levels – subsystem, unit and components – and are actively being investigated through numerous studies and testing activities. Opening the outer structure of the spacecraft as early as possible, during re-entry, helps to improve the overall demise. New technologies are therefore needed to open and/or release the external structural elements and spacecraft modules. To assess the potential for demise, a first evaluation of the currently used joining techniques, and the processes at play during their demise occurred. This enabled the identification of different techniques and methods, which could be used to cause an earlier joint demise. Results showed a considerable preference towards leveraging the introduced heat, enabling a clear and decisive separation. Six of these concepts were then selected, and further developed. Technical design considerations were combined with the potential effects on the safety, processes and potential costs. The concepts included: shape memory alloy cylinders, cleats with soldered segments, two part inserts using solder material, cleats bonded to the surfaces of the panels, and composite inserts. Each concept was then developed into a breadboard model. The two part inserts,

bonded cleats, and composite inserts, then underwent a range of tests (in a wind tunnel and re-entry chamber). Testing compared the demiseability with the current state-of-the-art technology, and assessed their demise performance. The results, as reported in this paper, will assist in making future informed and important demise decisions. The fundamental objective is to improve the demise of any given spacecraft, and by association, reduce the casualty risk on the ground. This can be achieved with the utilisation of demise technology, and structural joining approaches in future spacecraft.