

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Technologies for Future Space Transportation Systems (5)

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DESIGN, DEVELOPMENT AND TESTING OF THE INFLATABLE STRUCTURE AND ITS  
GROUND DEMONSTRATOR FOR THE EFESTO PROJECT (ADVANCED EUROPEAN RE-ENTRY  
SYSTEM BASED ON INFLATABLE HEAT SHIELDS)

**Abstract**

The European Union H2020 EFESTO project has the end goals of improving the European TRL of Inflatable Heat Shields for re-entry vehicles (from 3 to 4/5) and paving the way towards further improvements (TRL 6 with a future In-Orbit Demonstrator, IOD). Two different applications have been identified and studied in the frame of the project: Mars application, based on the final goal to safely land a 2.5 ton payload at MOLA +3 km target altitude with a combination of 9 m diameter Hypersonic Inflatable Aerodynamic Decelerator (HIAD) class and a Supersonic Retro-Propulsion system; and Earth Application, based on the goal to re-entry and recovery Launcher's components with the VEGA upper stage (AVUM) as baseline case study. In both applications, the EFESTO project effort was particularly addressed to the maturation of the two key technologies constituting the core of Inflatable Heat Shields: the Flexible TPS and the Inflatable Structure. This paper provides an insight into the effort related to the design of the EFESTO Inflatable Structure for both Mars and Earth application scenarios, as well as to the development and testing of a Ground Demonstrator. The engineering excursus from EFESTO system-level requirements to Inflatable Structure sub-system detailed design is described and details are presented about how the process was supported by system and technology-driven considerations, on the one hand; and, on the other, by structural modelling, simulations and analysis. Architectures identification and trade-off, interface engineering, budgets definition, and technology-related design aspects are also presented. A particular focus on the design of a 1:2-scale Ground Demonstrator of the Inflatable Structure is provided along with the technical achievements of manufacturing, integration and testing.

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