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ADDITIVE LAYER MANUFACTURING FOR ENTRY CAPSULES.

Abstract

CIRA is designing and realizing the structures, mechanisms and Thermal Protection System (TPS) of a capsule conceived for the demise observation of upper stages of various launch vehicles. The purpose of the project is to produce a completely autonomous capsule able to sustain re-entry, and devoted to the study and observe the demise of launch vehicle stages. The analysis of the re-entry data on objects re-entering the atmosphere will help in accurately predicting break-up altitudes, debris trajectories and ground impact footprints. These analyses are therefore critical not only for mission success, but more importantly for improving public safety aspects of such re-entry scenarios. The capsule will be connected to the same launcher stage it will monitor and observe during the re-entry. Once in orbit, the capsule will wake-up and will perform its measurements and observations. It will remain connected to the launcher stage during the first part of the re-entry, but it will decide to disconnect from launcher when its host starts to disintegrate. In a fall towards the Earth, it will continue making measurements and at the same time relay its measurement data to ground. The capsule must be constructed such that it will be able to withstand the hostile conditions of the launch, the re-entry and close-by disintegration of the launcher. The project is halfway its duration. For the program an Engineering Qualification Model (EQM) shall be produced as well as a Proto-Flight Model (PFM). Because the tight schedule, the small size of the capsule, about 30 cm in diameter, and the small number of items to be produced for this particular mission, CIRA has selected a rapid prototyping system for the manufacturing of the EQM and PFM. In particular, the structural parts of the PFM shall be made by Titanium alloy using the Electron Beam Manufacturing (EBM) capabilities owned by CIRA. This technique permits to generate very complex shapes at the same cost of simple shapes. This permits the designer to achieve higher shape and structural efficiency. The paper shows how the peculiarities of the ABM are exploited and how the “think-additive” approach is interpreted for this manufacturing case. In particular, the paper describes some of the design solutions aimed to minimize the need of post fabrication machining. The capsule main structure is made by two pieces that are bolted together.