Paper ID: 74055
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advanced Materials and Structures for High Temperature Applications (4)

Author: Mr. Gianmarco Floro
Politecnico di Torino, Italy, s305113@studenti.polito.it

Ms. Angela Tosti
Politecnico di Torino, Italy, s305129@studenti.polito.it
Mr. Federico Giraldo
Politecnico di Torino, Italy, fede.giraldo97@gmail.com

PRELIMINARY DESIGN OF THE HEAT SHIELD FOR A MARS ENTRY VEHICLE

Abstract

Mars has been the target of many contemporary missions and others are planning to be launched in the near future. About fifty percent of the missions on Mars have failed, most of them due to errors in the landing phase. Major criticalities were identified in the thinner atmosphere than Earth, requiring more abrupt braking, together with the communication delay between planets that forces completely automated maneuvers. Alongside, the systems must survive in space several months before arriving near the planet. Earth's atmosphere is about a hundred times denser than Martian's one, and this causes the vehicle to brake at lower altitudes, leaving less time for Entry, Descent and Landing (EDL) maneuvers. One of the key design parameters of the thermal conditions experienced by entry vehicles is the ballistic coefficient (BC). Reducing the BC is mandatory to produce enough drag to decelerate larger entry masses and to reduce the thermal load during the entry phase.
The Thermal Protection System (TPS) provides spacecrafts entering the atmosphere with the thermal protection from the aerothermodynamic heating. The TPS sizing is crucial to withstand the high heat fluxes, meanwhile, its weight must be minimized in the optics of respecting the mission's mass budget.
The aim of this paper is to describe the preliminary design of the heat shield for a spacecraft performing an entry maneuver on Mars. This study has been carried out in the framework of a pre-phase A mission design of a crewed transfer vehicle for a mission to Mars, involving a descent element. It was performed by the students of Politecnico di Torino, ISAE-Supaéro, and University of Leicester, during the Project Work developed for the XIV edition of the International Specializing Master programme in SpacE Exploration and Development Systems (SEEDS), with the support of ASI, CNES, ESA, and space industries, such as Thales Alenia Space and ALTEC.