

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
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CMC WINDWARD TPS AND NOSE OF THE IXV VEHICLE : FULL-SCALE MANUFACTURING,  
QUALIFICATION, AND INTEGRATION

**Abstract**

The launch of the Intermediate eXperimental Vehicle will represent a major achievement, with the first European in-flight demonstration of some of the most advanced technologies in the field of re-entry. In particular, this vehicle will rely on a large array of C-SiC based thermal protection systems, in development for many years, but still to be completely validated through an actual spacecraft application.

Herakles, Safran, has been entrusted since 2008 with the development and qualification of two of the most critical TPS subsystems of the vehicle : the nose and the panels covering the major part of the windward area, two of the most heated areas during re-entry. After a successful CDR outcome in 2011, these subsystems are currently well into the middle of the qualification and flight model manufacturing phase.

The technology developed for these applications combines a high-temperature resistant C-SiC outer shell, mechanically fastened to the structure of the vehicle, and internal lightweight insulation layers. These systems have to comply with a set of very strict requirements related to the harsh environment of atmospheric re-entry, combined aerodynamic shape control and mass objectives. Consequently, a large number of test campaigns have been performed throughout the detailed design phase, addressing the different components of the subsystems, with particular focus on C-SiC parts and on integrated subsystem performance.

Manufacturing of the components of the Qualification Model, as well as the Flight model, has been a challenge. This paper will provide an overview of the main steps of the hardware production. It will also present the results of the qualification tests, that comprise both dynamic tests and thermal and mechanical tests on a series of full-scale parts representing the nose of the vehicle and the most critical areas of the windward TPS. Finally, an overview of the integration activities that have been performed during the assembly of the components onto the vehicle will be provided.