

DEVELOPMENT AND QUALIFICATION OF CARBON-CARBON LEADING EDGES FOR SCRAMJET ENGINE APPLICATIONS

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Abstract

The leading edges of various hardware of the scramjet engine will experience severe aerothermal loads during the hypersonic flight. Carbon-Carbon composites, because of its long heritage, worldwide, as thermo-structural product, are selected as the prime choice for Boundary Layer Splitter Leading Edge and Strut Leading Edge. Different material development approaches were identified in view of the end attributes of these products. Limited availability of the raw materials in the open market posed challenges in the material development. While judiciously deciding the combination of processes, available facilities were optimally utilized in the development of these leading edges. Machining parameters, optimum tool requirements, fixturing concept etc. were identified and streamlined. To evaluate the integrity of these components and the effectiveness of the SiC coating at elevated temperatures, qualification tests were carried out in the Plasma Wind Tunnel Facility (PWTF) under the simulated flight conditions. This paper describes the details of the challenges faced in the process design and manufacturing and the details of thermo-structural qualification of these leading edges during the course of its development for its successful use in the scramjet engine experiment.

Keywords: Carbon-Carbon Composites, Scramjet, Boundary Layer Splitter, Strut Leading Edge