

DESIGN, ANALYSIS AND QUALIFICATION OF ENGINE FRAME STRUCTURE FOR SCRAMJET ENGINE

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Abstract

Design of Scramjet Engine Frame Structure offers challenges due to stringent specifications in geometry, structural mass and design of mounting interfaces for sub-systems. Scramjet engine mainly consists of engine frame structure (cold structure) and engine flow-duct (hot structure). The major subsystems viz. air intake cowl opening mechanism, avionics and propulsion system are mounted on engine frame structure. Detailed design of the Engine Frame Structure is carried out for expected loads during various critical flight events. The design is validated through rigorous Finite Element Analyses and further qualified through an intricate structural qualification program. Structural qualification tests of scramjet engine structure offers diverse challenges due to simultaneous application of loads acting on engine frame due to aerodynamics, inertia in longitudinal direction, loads due to spin of vehicle, concentrated loads at interfaces of sub-systems and application of differential pressure for vented structure. In order to carry out structural qualification tests, one unit of engine frame assembly is realised with critical interfaces similar to that in flight and qualified for ultimate load conditions. New concept of attaching sub-systems on engine frame for a spinning vehicle configuration is demonstrated by structural qualification tests which are well proven through flight test. This technical paper describes the details of structural design, analysis and structural qualification carried out for engine frame assembly.

Keywords: Cowl, Flow Duct, Intake, Frame, Cover, Shroud, Motor, Skin Panel, Whiffletree