AERO-THERMAL DESIGN, ANALYSIS, THERMO-STRUCTURAL TESTING AND QUALIFICATION OF RLV-TD

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Abstract

RLV TD is a lifting re-entry configuration with wing-body mounted on a solid booster. During atmospheric flight of RLV TD, which includes ascent as well as re entry into atmosphere, vehicles encounter severe thermal environment. The vehicle structure should be able to withstand this thermal load. Thermal environments were estimated for RLV TD and hot structures were designed.

To qualify the hot structures, thermo-structural testing has been undertaken. The demonstration of its fly-ability and qualification under the severe environment of thermal and structural loads acting simultaneously is carried out successfully for all hot structures.

Another critical area is the thermal management of electronic packages housed inside RLV fuselage. Thermal management of avionic packages inside RLV fuselage is also critical for the safe functioning of the packages. Detailed thermal analyses to estimate the prelaunch cooling requirements were carried out.

This paper gives the details of aero thermal design of various hot structures, Thermal Protection System (TPS) design of cold structures, thermo structural qualification of structures and thermal management of electronic packages. The comparison of estimated and flight measured temperatures is also provided. Fairly good comparison is seen between estimated and measured temperatures for hot structures and temperature of the windward and leeward region with TPS are well within limits. Safe functioning of packages was also ensured for the cooling design.

Keywords: RLV TD, Temperature, Heat Flux, Packages