

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures I - Development and Verification (Space Vehicles and Components) (1)

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STRUCTURAL LOAD TEST PROGRAMME FOR LVM3: TEST CONFIGURATIONS AND LESSONS
LEARNED.

Abstract

GSLV Mk-III (LVM3) has unique structural systems necessitating careful design and analysis as well as structural testing programme. The solid stage S200 has forward thrust transfer and concentrated single point thrust transfer dictates the design of the inter-stages. L110 stage is having three inter-stage structures, which are closely stiffened, and isogrid construction, which is predominantly tension load dominated. The C25 stage structures are truss type capable of handling thermal interface management. The propellant tanks of L110 and C25 are of monocoque construction. The Payload Fairing (PLF), Equipment Bay (EB) and Payload Adaptor (PLA) are composite structures. The test rig design, realisation and test execution is by Vikram Sarabhai Space Centre (VSSC) using the in-house facilities. The test programme is broadly classified into testing of room temperature tests of inter-stage structures, pressurised and cryogenic temperature tests and externally pressurised structures. The test facilities including test rigs, automatic hydraulic loading systems, instrumentation and data acquisition systems were realised at three facilities for conduct of these tests. Being tensile load dominated, interface stiffness simulation to ensure proper fastener loads becomes important. Combination of structures to ensure proper interface simulation is adopted in all the major tests. Preliminary tests to validate the design in carried out initially to ensure safety of tests. Analysis is carried for each hardware integrated with test rig with appropriate boundary conditions to ensure the loading pattern and state of stress. The hydraulic multipoint programmable automatic loading system is one of the unique designs which enabled smooth conduct of the tests with good accuracy. The system uses 16 point loading through a load diffusing adaptor to generate uniform or varying load density at the hardware interface. In the test facility established for pressurised and cryo hardwares, gas pressurisation and LN2 servicing systems with suitable control systems and remote operations have been realised. Presently, testing of all inter-stage structures (CBS, IS1/2L, ITS) and tanks (U-tank, N-tank (under testing)) of L110 stage, Base Shroud of S200 has been completed. The testing of EB and PLA is in progress. The major tests yet to be completed are the cryogenic tests of C25 tanks, PLF and S200 Nose cone assembly. The performance of the test facility and good match obtained with predictions add to the confidence in design. The lessons learned in the design of the test facility, test rigs and testing process are being elaborated in this paper.