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DEVELOPMENT AND QUALIFICATION OF A HIGH PERFORMANCE SOLID STRAPON MOTOR

Abstract

Polar Satellite Launch Vehicle (PSLV) has six solid strapon motors attached to the core motor.The generic baseline strapon motor, called S9 has 10m length 1m diameter segmented motor case loaded with 8.9 tons of HTPB based solid propellant. In order to increase the payload capability of PSLV for interplanetary missions like Chandrayaan and Mangalayaan, a new strap on motor (S12) was developed with new design features. The nozzle is a convergent-divergent type having 9 degree canting with in house processed carbon phenolic throat insert instead of imported graphite. Thrust vectoring is enabled with SITVC system with single pintle valve. The major features of the new motor compared to S9 are length increased by 3.44m to accommodate higher propellant loading, modified grain configuration, additional propellant loading of 3.37tons. In addition to this, modified segment joint with the introduction of capture feature, two O'rings, spherical nozzle convergent facilitating higher area ratio, standardizing propellant for all pyrogen igniters of all launch vehicles of ISRO and improved motor / nozzle interface avoiding the asbestos phenolic ring. The new motor was successfully designed, developed and qualified through two successful static tests. Elaborate measurements were carried out during testing including motor and igniter pressure, thrust, strain on hardware, temperature and dilation of the hardware. Post test studies indicated all subsystem performance was normal all the objectives of the tests were met. The new strapon motor increases the payload capability of PSLV by nearly 160 kg in 615 km Sun -Synchronous Polar Orbit. Subsequent to qualification tests, the motor was inducted in PSLV in the coveted Chandrayaan-1and communication/polar satellite launches including Mangalayaan missions in PSLV-C25. All motors performed as expected in 17 flights subsequent to the qualification tests. Further to the initial qualification tests during 2005-2006 period, four more static tests were conducted recently to evaluate the performance of newly developed asbestos free inhibition, modified segment joint interface and modified igniter as well as qualification of new propellant processing plant. The achieved ballistic performances of the motor fight were very close to the pre-fight prediction, and all the performance parameters were well within the mission limits. The challenges faced in the design, development, realization, qualification of the motor and performance of the fight motor is presented in detail.