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DESIGN CRITICALITIES AND STRUCTURAL INTEGRITY ANALYSIS OF THE SPIN-STABILIZATION SOLID ROCKET MOTOR CHARGED WITH HIGH ENERGY GRAIN

Abstract

The RH series rockets (with diameter 300 mm and 560 mm) are employed with small sized solid propellant based motors which impart an initial spin to the rocket for its stabilization and thus keep it from drifting off course. As soon as the main rocket is launched, two diametrically opposite fin-mounted spin motors are ignited, and are separated one second after the ignition command is received. The design of modern high spin solid propellant rocket motors is critical as its operability requires a high energy grain with a very small action time. The burning of the high energy grain produces a very high internal pressure, thus imparting the spin to the rocket as soon as it is launched. The basic design of the spin rocket comprises of two coaxial tubes welded to each other at their ends. The motors are energized using cordite grain (propellant) in the rear tube by ignition cartridge mounted on the end of the tube. The end of the front tube holds the ballast. The design of the spin rocket is not limited to the estimation of design factors based on the performance of propellant grain, choice of high strength mechanical to ensure low ratio of passive weight of the rocket motor and propellant grain weight, and the design of the joint with the end cap and the production technologies which ensure appropriate product quality with reasonable costs. This paper lists a careful assessment of the materials for the rocket motor case, their physical and mechanical properties which are critical to the design with respect to the high internal pressure. The usage of numerical tools for the design becomes imperative for achieving an optimal design. The authors have extensively used Finite Element Analysis to assure the structural integrity of the spin motor and ensure positive design margins.