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REPORT ON RETRO-ROCKET/BRAKING SOLID ROCKET MOTOR DEVELOPMENT

Abstract

Various suborbital and orbital missions as well as new generation of small/medium satellite launchers require accurate, low cost and reliable retro-rocket/braking motors. While specific impulse by itself is an important performance parameter for a rocket motor, other parameters are also important for a retro-rocket/braking motor such as: ignition time, tail-off time, thrust-curve stability at different initial temperatures, reliability and low cost. A 1.4 kN multi-nozzle short burn-time solid rocket motor has been developed in support of braking operations for various launcher and/or suborbital/orbital missions. A low cost architecture was used for the solid rocket motor construction in order to offer an affordable and reliable propulsion unit. An in-house igniter unit is developed in order to ensure successful ignition of the relatively small solid rocket motor. The solid rocket motor used double base propellant and exhibited fast ignition times with short tail-off durations with unrestricted burning surfaces. Three test firings were performed at: -32 degrees Celsius, normal temperature conditions and +50 degrees Celsius and proved stable operation with one observation that at -32 degrees Celsius the ignition system has to be modified in order to provide a higher initial pressure. Both thrust and pressure curves are measured for all three test firings. An interior ballistic model has been developed using FORTRAN programming language and its results are compared with the experimental test firings. The interior ballistic model contains an erosive burn-rate component which provides an excellent match with the experimental firings especially in the first half of the burn-time interval. A discussion is made for the comparison of simulation and experimental data for each test firing at different initial fuel grain temperatures. Also Monte Carlo study is made in order to study the main performance parameters dispersion as a function of motor functional dimensions.