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ERROSIVE BURNING MODELLING ON SOLID ROCKET MOTORS. APPLICATION TO DEVELOPMENT OF SRM 120.

Abstract

Solid rocket motors are still prefered for a variety of missions due to their simplicity, high reliability and relatively low cost when compared to other propulsion methods. Various solid rocket motors models have been developed in order to allow their accurate design. Key performance parameters have been investigated and various geometrical solutions have been chosen in order to increase the performance of a given solid rocket motor. The key parameter in such models is the burnrate and its accurate prediction in the pressure and temperature conditions available inside combustion chamber. We have undertaken the development of a 120 solid rocket motor (SRM 120) for a suborbital vehicle. The motor aims at producing 750 kgf for 8 seconds of burntime while using a steel combustion chamber with filleted end-cap and nozzle. The propellant has a cylindrical geometry with an central burning core and it is composed of 10 identical segments. Details are given on both the construction and the firing test preparation of the motor since this represents important knowledge for the subsequent operation of the motor. The thrustcurve is measured together with key performance parameters on a horizontal test stand. An internal ballistic model is developed for SRM 120 with the aim to accurately its performance parameters. The model incorporates both start-up and tailoff phases, including the start-up using pressure membrane as used on many solid rocket motors. The burnrate is first shown to depend only on pressure and comparison between theoretical and numerical data is done. Comparison is done with test stand measurements and sign of errosive burning is indicated. A detailed model for errosive burning starting from first principles is described and implemented within the abovementioned internal ballistic model. Further we change the numerical model to incorporate the errosive burning and compare again numerical results with the experimental measurements. We show good agreement between the numerical results and experimental data and indicate methods through which negative impact of errosive burning can be diminished.