Paper ID: 88047
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IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (2) (4)

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CHALLANGES IN VERIFICATION PROCESS OF THE SOLID ROCKET MOTOR FOR DIRECT DEORBITATION ENGINEERING MODEL

Abstract

Space debris is a growing concern that poses a threat to the future use of Earth's orbit. To address this issue, the Łukasiewicz Research Network - Institute of Aviation (Lukasiewicz – IoA) is currently developing the Solid Propellant De-orbit Motor Engineering Model project for the European Space Agency (ESA). Ultimately, such motors could be mounted on satellites and enable their safe removal from orbit or transfer to the graveyard orbit after their mission is completed. Due to their high reliability and density specific impulse, solid propellant motors are considered one of the most suitable solutions for direct deorbitation. For the motor to fulfil its tasks, it must be characterized by, among other things, a long stay in orbit and a high ΔV, which, considering the requirement for limited thrust, is associated with a long burn time. The motor itself cannot contribute to the generation of more space debris. Therefore, there must be no solid particles in the exhaust gases. These requirements pose numerous challenges to the verification process. The following article outlines the approach taken by the IoA to address these challenges. This paper presents the general design of the motor and the requirements imposed on it. Then, the verification process is described. The work describes tests of the mechanical and thermodynamic properties of insulating materials, as well as ablation tests using an oxy-acytelene burner. The article also describes tests related to propellant grain, including inhibitor and propellant peeling tests. Next, the test campaign approach of the ignition system is described. The article also presents environmental tests carried out on the engineering model. The motor's static fire tests and the parameters measured during them were also presented, which also included tests related to the TVC system being developed by Lukasiewicz – IoA. Finally, the tests that will have to be carried out at the stage of qualification of the flight motor are presented.