

IAF SPACE PROPULSION SYMPOSIUM (C4)
Joint Session between IAA and IAF for Small Satellite Propulsion Systems (8-B4.5A)

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PMD AND VOLUME EFFICIENT DESIGNS OF CUBESATS AM GREEN PROPELLANTS STORAGE

Abstract

The propellant tank or storage compartments have experienced noted advancements in the design nature, mainly the shape and the structural properties, as well as the development process. Additive Manufacturing (AM) techniques are playing a crucial role in the aforementioned developments. In order to achieve high propulsion system performance, inert mass reduction as well as efficient volume utilization can be considered as of the main attributes to concern the system designer. Mass reduction of a structure is one of the AM virtues that is easily achieved in early prototyping and design phases. Another important attribute is the Volumetric Efficiency; In the recent years and along the upsurge of components miniaturization activities, it was noted that CubeSat Propellant Tanks tend to have more oblate and squarish extremities rather than the standard spherical and cylindrical shapes. This squarish shape feature helps in utilizing the dead-corners of a CubeSat module more effectively, especially in the favor of increasing the propellants capacity. Cubic shaped propellant storage tanks appeal when considering the mass and volume efficiency aspects, but unfortunately more challenges emerge when addressing the propellant management operation if compared to the conventional spherical shapes. Propellant management devices in CubeSats are usually practically restricted within employing several options, such as: elastic diaphragms, actuated expulsion mechanisms, surface tension components, or gas pressurization. In this paper, the proposed tank design will be presented in the context of the current state-of-the-art of propellant storage items for CubeSat propulsion. The manufacturing techniques and used materials as well as the structural integrity will be studied and discussed. Moreover, the challenges related to the propellant management devices (PMDs) will be carefully discussed while unsolved (or pending-solution) challenges in the propellant management aspect will be clearly highlighted for future research ventures.

References:

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