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QUALIFICATION OF 3D PRINTED POLYMERIC STRUCTURE IN HEPD-02 INSTRUMENT

Abstract

In this talk we present the verification and product assurance approach used to mitigate risks associated with the use of non-qualified processes, specifically Additive Layer Manufacturing (ALM) of polymers, in the CSES/Limadou space programme for the second China Seismo-Electromagnetic Satellite (CSES-02) set to launch at the end of 2023. ALM processes are considered critical, and many factors can influence the properties of the final product, making quality assurance actions crucial for mission success. While the European Space Agency recently introduced a standard on ALM to address the increasing demand for the adoption of this technology by the space industry, it mainly addresses the use of metallic materials and only provides a general approach to other technologies and materials. This study focuses on the High Energy Particle Detector (HEPD-02) instrument design, which includes the use of 3D-printed polymeric parts, specifically PEEK (polyether-ether-ketone) via Fused Filament Fabrication (FFF also known as FDM). The use of PEEK via FFF has been proposed to create small support structures, such as wire holder supports, to speed up the production process and make spare parts readily available on demand. However, a specific review of the design, analysis, and qualification process was necessary to allow for the use of FDM technology and ensure the final product's quality and compliance with the space environment. The qualification method used in this study was a two-step approach. The first step established requirements for reviewing the CAD design in relation to specific technology limits, such as sharp edges and minimum width, to ensure the adoption of the proper design technique and plan the appropriate process parameters. The second step aimed to verify the quality of production by testing and inspection. Ultimately, the qualification results have been reported. In this talk we highlight the importance of a rigorous qualification flow when using ALM for space applications, especially when using non-qualified processes for new materials and technologies. The results of this study provide valuable

insights into the verification and product assurance approach needed to ensure the quality of products produced using ALM and new materials for space applications.