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Author: Dr. Marco Mulser
OHB System AG, Germany

Mr. Moritz Samoil
OHB System AG-Bremen, Germany
Mrs. Carolin Greve
OHB System AG, Germany
Mr. Pascal Vermeer
OHB System AG, Germany
Dr. Eike Volkmann
OHB System AG, Germany
Mr. Guy Perez
OHB System AG, Germany
Mr. Michael Lippert
Fraunhofer Research Institution for Additive Manufacturing Technologies IAPT, Germany
Mr. Christoph Katzenschwanz
Altair Engineering GmbH, Germany
Dr. Martina Meisnar
European Space Agency (ESA/ECSAT), United Kingdom
Dr. Laurent Pambaguian
European Space Agency (ESA/ESTEC), The Netherlands

VERIFICATION OF SPACECRAFT PARTS MADE BY ADDITIVE MANUFACTURING

Abstract

Many studies that addressed the development of Additive Manufacturing (AM) have shown that the technology provides many potential improvements compared to conventional manufacturing. The technology offers a unique design freedom and new opportunities to manufacture structural and multi-functional parts with high complexity. Due to the low lot sizes typical for the space industry, AM shows several promising benefits for future satellite applications. Performance gain through functional integration, reduction of the number of parts and interfaces of an assembly, shorter lead times and mass savings are the main drivers for considering AM in spacecraft design.

A robust and reliable end-to-end process chain is the key to ensure the required part quality. Experience shows that AM material properties differ from those of established conventional materials. The material is generated during the process itself, and the characteristics are therefore not available in a common material database. Generally, the quality of AM parts depend on the powder quality, the applied set of process parameters, the utilized machine type and the individual experience of the part supplier. Process parameters are developed by each manufacturer and a transfer between suppliers or even between machines is not possible, as it is the case in conventional manufacturing. Thus, reproducibility and repeatability of batch-to-batch production are key aspects of quality assurance to mature the technology.

In this paper, OHB's general methodology for material validation, process control and part verification for Laser Powder Bed Fusion (L-PBF) is presented. The draft of the ECSS-Q-ST-70-80C on "Processing and quality assurance requirements for metallic powder bed fusion technologies for space applications"

was used as a baseline. The approach for part verification is explained by means of a study case which is a recently developed structural bracket made of Ti-6Al-4V. The bracket serves as a panel-to-panel connector providing well-defined stiffness characteristics to compensate thermally induced deformations between aluminium and CFRP sandwich panels. The part has been developed within the European Space Agency (ESA) funded General Support Technology Programme (GSTP) activity entitled "Additive Manufacturing Maturation" under the lead of OHB System in a consortium with Fraunhofer IAPT and Altair Engineering. Customized tests were added to verify the new bracket against the requirements for its specific function.