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METAL 3D PRINTER TECHNOLOGY DEMONSTRATOR; IN ORBIT DEMONSTRATION OF PRINTING 3D METAL PARTS

Abstract

With the launch of the Metal 3D Printer Technology Demonstrator (Metal 3D TD) on NG-20 on January 30th, 2024, the European Space Agency (ESA) will establish the first metal 3D printing capability in the International Space Station. One month later, the Metal 3D TD is installed as a sub-rack payload for the European Drawer Rack Mark II (EDR2) in the ESA Columbus Laboratory of the International Space Station.

The Metal 3D Printer is based on an Additive Manufacturing Machine that will demonstrate direct energy metal deposition in 3D under sustained microgravity conditions, through the manufacturing of several test specimens.

The objectives of the Metal 3D Printer activity include understanding the performance of the printer in terms of specimen accuracy and quality; and familiarising with its operations in a space habitat context, both from the perspective of crew as well as ground operators. This will serve as a stepping stone the

develop a metal 3D printing capability which is able to offer on-demand functional parts to astronauts and support future in-orbit manufacturing of space systems.

Operations will start in March 2024 and aim to print 4 specimens, to be downloaded to ground for further processing and analysis. The printed specimen will address several areas of investigation into the characteristics and the use of the printed and its products. Printing of each specimen is expected to take 2 - 4 weeks, with a total operational time (including printer reconfiguration) in the order of 6 months. After printing, the specimen will be retrieved from the Metal 3D TD and downloaded to ground.

Upon download the printed specimens will be postprocessed and analysed, to assess their micro- and macro structural characteristics and mechanical properties. The results will be compared with both reference data for 316L stainless steel as well as 1xg reference samples printed with both the Metal 3D Flight Model and the Ground Model.

Based on the development and operations of the Metal 3D Printer, as well as on the results from the post-processing, recommendations will be identified to support the next steps towards establishing a 3D metal printing capability for future human and robotic exploration, in particular for long duration, long distance missions.

The Metal 3D Printer technology demonstrator is developed by an industrial team led by Airbus Defence and Space, under a contract with the European Space Agency, co-funded by Airbus Defence and Space.