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HYDRAULIC DEVELOPMENT TESTING OF THE PRESSURIZATION CONCEPT FOR THE ORION-ESM PROPULSION SYSTEM

Abstract

The Orion Multi-Purpose Crew Vehicle (MPCV) is the next generation spacecraft that NASA currently develops to send humans and cargo to the moon and beyond and return them back to earth safely. The vehicle, which will be launched by the new Space Launch System (SLS), is designed to support long-duration deep space missions. The first exploration mission is planned to take place end of 2019 as an uncrewed lunar flyby mission followed by a second exploration mission in 2023 taking astronauts to the moon. The MPCV resembles its Apollo predecessors and will consist of a habitable Crew Module (CM) and a disposable European Service Module (ESM) that provides power, life support, and in-space propulsion. The ESM is subcontracted to ESA with Airbus DS GmbH as industrial partner being responsible for its development.

This paper presents the findings of the hydraulic development tests of the pressurization system of the ESM propulsion subsystem. To pressurize the propulsion subsystem, an electrical pressurization concept is used on the man-rated spacecraft. The pressurization system mainly consists of a series of bi-stable and mono-stable solenoid valves that are commanded by a dedicated pressure regulation unit. For activation and deactivation of the mono-stable regulation valves, the pressure regulation unit acquires and evaluates a set of tank pressure values and commands the valves accordingly. The overall pressurization concept was tested in ArianeGroup's Lampoldshausen Test Facility, the results of which are detailed in the full paper. Besides proving the capabilities of the nominal regulation behavior, an unexpected regulation behavior was observed, which led to a re-definition of the operational concept, while keeping the hardware set-up unchanged. The findings and anomaly investigation are discussed as well as the modified operational logic of the bang-bang system.