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VERIFICATION AND GROUND QUALIFICATION APPROACH FOR THE STRUCTURE OF THE ORION-MPCV EUROPEAN SERVICE MODULE

Abstract

This paper presents an overview of the verification and ground qualification approach for the structure of the European Service Module of the Orion Multi-Purpose Crew Vehicle, currently undergoing qualification test activities. Under an agreement between NASA and ESA, the new NASA Multi-Purpose Crew Vehicle (MPCV) for human space exploration missions will be powered by a European Service Module (ESM), based on the design and experience of the ATV (Automated Transfer Vehicle). The development and qualification of the European Service Module (ESM) is managed and implemented by ESA. The ESM prime contractor and system design responsible is Airbus Defence and Space, while Thales Alenia Space Italia is responsible for the design and integration of the ESM Structure and Micro-Meteoroids and Orbital Debris Protection (MDPS), the Thermal Control System and the Consumable Storage System. The Multi-Purpose Crew Vehicle (MPCV) is a pressurized, crewed capsule that transports up to four crew members from the Earth's surface to a nearby destination or staging point, and brings the crew members safely back to the Earth's surface at the end of a mission. The MPCV provides all services necessary to support the crew members while on-board for short duration missions (up to 21 days) or until they are transferred to another element. The European Service Module supports the crew module from launch through separation prior to re-entry. It provides in-space propulsion capability for orbital transfer, attitude control, and high altitude ascent aborts. It provides the water and oxygen needed for a habitable environment, generates electrical power, and maintains the temperature of the vehicle's systems and components. The ESM structure qualification logic at structure assembly level included static stiffness test, acoustic tests, sine vibration tests, shock tests, limit and ultimate static test. The tests have been performed on fully representative structural models, some of them in Turin (Italy) and NASA Plum Brook, Ohio (US). The E-STA structural model used for the Acoustic test in the Plum Brook reverberant chamber was also exposed to a Direct Field Acoustic Test (DFAT), aimed to demonstrate an alternative approach for efficient testing of Orion MPCV flight production modules. The MDPS testing involved an

extensive Hyper Velocity Impact (HVI) test campaign performed at NASA's White Sands test range. The main test results are presented and discussed in the paper.