

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures I - Development and Verification (Space Vehicles and Components) (1)

Author: Mr. Gandolfo Di Vita
European Space Agency (ESA), The Netherlands, gandolfo.divita@esa.int

Mr. Goncalo Rodrigues
European Space Agency (ESA), The Netherlands, Goncalo.Rodrigues@esa.int

Mr. Guillaume Dussardier
ArianeGroup SAS, France, guillaume.dussardier@ariane.group

Mr. Antoine Alouani
ArianeGroup, Germany, antoine.alouani2@ariane.group

Mr. Stefano Scalisi
Thales Alenia Space Italia (TAS-I), Italy, Stefano.Scalisi@thalesaleniaspace.com

Mr. Moreno Faraud
Thales Alenia Space Italia (TAS-I), Italy, Moreno.Faraud@thalesaleniaspace.com

Mr. Ghosn Louis J.
NASA Glenn Research Center, United States, louis.j.ghosn@nasa.gov

Ms. Sofia Caeiro
ESA - European Space Agency, The Netherlands, sofia.caeiro@esa.int

Mrs. Tiziana Cardone
ESA - European Space Agency, The Netherlands, tiziana.cardone@esa.int

Mr. Andrea Amaldi
ESA - European Space Agency, The Netherlands, andrea.amaldi@esa.int

Mr. Ryan Proud
NASA, United States, ryan.w.proud@nasa.gov

Mr. Paolo Palmieri
Thales Alenia Space Italia (TAS-I), Italy, Paolo.Palmieri@thalesaleniaspace.com

Mr. Gerben Sinnema
European Space Agency (ESA-ESTEC), The Netherlands, gerben.sinnema@esa.int

DESIGN OPTIMISATION AND MASS SAVING OF THE STRUCTURE OF THE ORION-MPCV
EUROPEAN SERVICE MODULE

Abstract

This paper presents an overview of all the design optimisation measures that have been proposed, analysed and implemented in order to reduce the mass of the structure, including the MMOD (Micro-Meteoroid and Orbital Debris) protection system, of the ESM (European Service Module) for the “Orion” MPCV (Multi-Purpose Crew Vehicle). Under an agreement between NASA and ESA, the new NASA Multi-Purpose Crew Vehicle (MPCV) for human space exploration missions will be powered by an 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 (MMOD) protection system, in addition to the Thermal Con-

trol System and the Consumable Storage System. The Orion 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 the 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 and stores electrical power, and maintains the temperature of the vehicle's systems and components. The ESM has been designed and qualified for the first 2 Orion MPCV missions to the Moon orbit, EM-1 (Exploration mission 1), unmanned flight planned at the end of 2019 and EM-2 (Exploration Mission 2), manned flight planned in 2022 or 2023. The mass saving of the Service Module, object of this paper, has been considered necessary, together with other improvements like the introduction of the parallel tanks propellant depletion, to consolidate the ESM design and make possible future different missions beyond EM-1 and EM-2. The mass saving study has introduced new optimized structural concepts, optimization of the MMOD protection shields, optimized redesign of parts for manufacturing through 3D printing technologies. Keywords: Orion-MPCV, Structure, Mass-saving