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

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DEVELOPMENT & TESTING OF THE SINGLE-PERSON SPACECRAFT CREW ENCLOSURE

Abstract

The Single-Person Spacecraft (SPS) is being developed by Genesis Engineering Solutions (GES) to provide the space industry with a new piloted and remotely operated EVA solution. The SPS provides a free-flyer inspection, construction, and transportation solution for host vehicles and stations such as the upcoming Lunar Gateway. Hardware for the primary structure is being designed, built, and is undergoing ground testing for a Demonstration Mission which will validate several key SPS systems in LEO. The pressurized habitable module of the SPS, referred to as the crew enclosure, is comprised of an Aluminum 2219-T851 weldment, a LEXAN DL5034 Polycarbonate dome, and Aluminum 6061-T6 ancillary components. The weldment was manufactured by AMRO Fabricating Corporation, a SPS partner specializing in metallic aerospace structures. A double weld lap joint was developed to provide redundancy in the structure. Weld strength of the joint was qualified at 39.5 ksi with fracture occurring in the heat affected zone. The SPS operates at standard atmospheric composition and pressure so a Maximum Expected Operating Pressure (MEOP) of 15.2 psi was established for the crew enclosure. Pressure testing the crew enclosure was performed for structural verification by proof testing to 1.5 times MEOP and leak testing the primary and all redundant weld and seal volumes at MEOP. Leak testing was performed using the pressure decay technique and leaks were located using the localized bubble emersion method. Redundant volumes demonstrated leak rates between 3.2 x 10-2 to 9.7 x 10-5 kg/day demonstrating a leak rate superior to modern spacesuits (EMU) and similar to International Space Station (ISS) levels. Efforts are ongoing to determine the primary volume leak rate. A discussion on the fabrication, weld characterization, pressure testing, and future strength verification tests along with all results and lessons learned will be included in the final paper. This work, including the precursory design analysis, presents a significant accomplishment towards the SPS Demonstration Mission. This material is new and has not been publicly shared previously.