Z-2 Architecture Description and Requirements Verification Results Abstract

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The Z-2 Prototype Planetary Extravehicular Space Suit Assembly is a continuation of NASA's Z series of spacesuits. The Z-2 is another step in NASA's technology development roadmap leading to human exploration of the Martian surface. The suit was designed for maximum mobility at 8.3 psid, reduced mass, and to have high fidelity life support interfaces. As Z-2 will be man-tested at full vacuum in NASA JSC's Chamber B, it was manufactured as Class II, making it the most flight-like planetary walking suit produced to date.

The Z-2 suit architecture is an evolution of previous EVA suits, namely the ISS EMU, Mark III, Rear Entry I-Suit and Z-1 spacesuits. The suit is a hybrid hard and soft multi-bearing, rear entry spacesuit. The hard upper torso (HUT) is an all-composite structure and includes a 2-bearing rolling convolute shoulder with Vernier sizing mechanism, removable suit port interface plate (SIP), elliptical hemispherical helmet and self-don/doff shoulder harness. The hatch is a hybrid aluminum and composite construction with Apollo style gas connectors, custom water pass-thru, removable hatch cage and interfaces to primary and auxiliary life support feed water bags. The suit includes Z-1 style lower arms with cam brackets for Vernier sizing and government furnished equipment (GFE) Phase VI gloves. The lower torso includes a telescopic waist sizing system, waist bearing, rolling convolute waist joint, hard brief, 2 bearing soft hip thigh, Z-1 style legs with ISS EMU style cam brackets for sizing, and conformal walking boots with ankle bearings.

The Z-2 Requirements Verification Plan includes the verification of more than 200 individual requirements. The verification methods include test, analysis, inspection, demonstration or a combination of methods. Examples of unmanned requirements include suit leakage, proof pressure testing, operational life, mass, isometric man-loads, sizing adjustment ranges, internal and external interfaces such as in-suit drink bag, partial pressure relief valve, purge valve, donning stand and ISS Body Restraint Tether (BRT). Examples of manned requirements include verification of anthropometric range, suit self-don/doff, secondary suit exit method, donning stand self-ingress/egress and manned mobility covering eight functional tasks. The eight functional tasks include kneeling with object pick-up, standing toe touch, cross-body reach, walking, reach to the SIP and helmet visor.

This paper will provide an overview of the Z-2 design. Z-2 requirements verification testing was performed with NASA at the ILC Houston test facility. This paper will also discuss pre-delivery manned and unmanned test results as well as analysis performed in support of requirements verification.