Space Suit Portable Life Support System (PLSS) 2.0 Unmanned Vacuum Environment Testing

For the first time in more than 30 years, an advanced space suit Portable Life Support System (PLSS) design was operated inside a vacuum chamber representative of the flight operating environment. The test article, PLSS 2.0, was the second system-level integrated prototype of the advanced PLSS design, following the PLSS 1.0 Breadboard that was developed and tested throughout 2011. Whereas PLSS 1.0 included five technology development components with the balance the system simulated using commercial-off-the-shelf items, PLSS 2.0 featured first generation or later prototypes for all components less instrumentation, tubing and fittings. Developed throughout 2012, PLSS 2.0 was the first attempt to package the system into a flight-like representative volume. PLSS 2.0 testing included an extensive functional evaluation known as Pre-Installation Acceptance (PIA) testing, Human-in-the-Loop testing in which the PLSS 2.0 prototype was integrated via umbilicals to a manned prototype space suit for 19 two-hour simulated EVAs, and unmanned vacuum environment testing.

Unmanned vacuum environment testing took place from 1/9/15-7/9/15 with PLSS 2.0 located inside a vacuum chamber. Test sequences included performance mapping of several components, carbon dioxide removal evaluations at simulated intravehicular activity (IVA) conditions, a regulator pressure schedule assessment, and culminated with 25 simulated extravehicular activities (EVAs). During the unmanned vacuum environment test series, PLSS 2.0 accumulated 378 hours of integrated testing including 291 hours of operation in a vacuum environment and 199 hours of simulated EVA time. The PLSS prototype performed nominally throughout the test series, with two notable exceptions including a pump failure and a Spacesuit Water Membrane Evaporator (SWME) leak, for which post-test failure investigations were performed. In addition to generating an extensive database of PLSS 2.0 performance data, achievements included requirements and operational concepts verification, as well as demonstration of vehicular interfaces, consumables sizing and recharge, and water quality control.