

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

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SIERRA NEVADA CORPORATION'S LIFE SOFTGOODS CERTIFICATION

**Abstract**

Sierra Nevada Corporation (SNC) is working in collaboration with NASA to complete the first ever certification of an inflatable softgoods habitat for crewed missions. SNC is developing the Large Inflatable Fabric Environment (LIFE), an inflatable soft goods habitat that is designed for long duration, crewed Mars missions. Inflatable softgoods structures enable the launch and on-orbit delivery of extremely large volume habitats using existing commercial launch vehicles. SNC's LIFE habitat design provides over three times the habitat volume of conventional hard structure habitats for similar structure mass and launch volume. Certification of the softgoods habitat design is necessary to ensure that the complex behavior of the softgoods structure is well understood, the inflatable habitat design is sufficiently robust, and the manufacturing processes are repeatable to meet space system human-rating requirements. One of the primary concerns of softgoods certification is characterizing the design and performance of the structural restraint layer. This layer must support the loads associated with the internal pressurized environment throughout the mission life. SNC has completed numerous tests on our softgoods configuration to inform the certification approach and has captured lessons learned as part of our on-going certification process. SNC's LIFE habitat restraint layer consists of a weave of vectran straps sized to carry pressure loads with appropriate factors of safety. To characterize the behavior of the LIFE restraint layer, SNC is executing a test campaign consisting of the following: strap-level tensile tests, sub-scale inflatable habitat burst and creep tests, and full-scale inflatable habitat burst tests. This test approach begins with component-level strap testing to determine tensile strength of individual vectran straps. This data is used to inform the vectran weave design of the flight article and to predict performance of the inflatable test articles. After component level testing, series of burst and accelerated creep tests are performed on one-third scale test articles. During burst testing, the test article's internal pressure is increased until structural failure. During accelerated creep tests, each test article is held at a different fixed pressure above the expected operating pressure. Initially, the vectran straps will strain in a near-linear fashion under the pressure load, until finally exhibiting non-linear rapid strain to failure. Upon successful completion of sub-scale article testing, full scale burst testing is performed to confirm the required factor of safety to meet certification requirements. SNC will discuss the unique aspects of softgoods verification for human habitation.