SBIR/STTR
Small Business Innovation Research / Small Business Technology Transfer

NASA SBIR 2015 Phase I Solicitation

H4.02 EVA Space Suit Pressure Garment Systems

Lead Center: JSC

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Space suit pressure garments technology developments are focused on providing enabling technologies for long-duration missions inclusive of extensive extra-vehicular activity (EVA). To that end, priority technologies address mass reductions, durability and reliability. Mass reduction for exploration pressure garments is driven, in addition to launch mass considerations, by the human factor of on-back weight for a planetary walking suit configuration following a long-duration micro-gravity transit, which may reduce astronaut load bearing capability. Driving reference missions such as a1.5-year Mars surface stay include on the order of 700 hours of EVA. Therefore, long-duration exploration missions require, in some cases orders of magnitude, increases in suit durability or new approaches to providing long duration mission EVA capability or logistics. The following technology areas address mass reduction, increased durability, or both.

Multi-function Materials

The pressure garment must perform functions such as: gas retention and structural integrity including fall cases; mobility to perform science and surface asset set-up and maintenance; and environmental protection from thermal extremes, micrometeoroids and secondary impacts, dust, and tears. The combination of performance of two or more of these functions in single pressure garment material layer contributes to mass reduction. For example, a composite structure that provides gas retention, structural integrity, and thermal protection/regulation would be beneficial. Another example would be a fabric that mitigates the effects of dust and is thermal protection in a single layer is sought.

Self-diagnosing and Self-healing Materials

Fabric wear due to repetitive joint cycling, dust and UV radiation exposure, and handling is anticipated. To improve safety and decrease crew time investment in the EVA system, materials that can indicate wear or self-heal are valuable. Current materials with these capabilities are heavy, stiff, or require prohibitive power quantities. Ideally, self-diagnosing and self-healing capabilities would be combined in with a material that also performs one of the functions described in the â€˜Multi-function materialsâ€™ section

Titanium Bearings

This topic addresses both mass reduction and increasing durability. The emphasis on mass reduction is countered by the need for increased mobility, which tends to increase mass due to the addition of low torques bearings in joint mobility systems. Titanium bearings are being incorporated to decrease the mass of joint mobility systems. However, refinement of titanium bearings to meet durability requirements is required based on 2014 bearing in-configuration oxygen compatibility testing, which passed for flammability, but indicated cycle wear issues. To address titanium bearing wear, coatings, treatments, lubricants, ball material, and space ball materials are all considerations to be investigated. Titanium bearings that can withstand 8 psi suit pressure plug loads in addition to suit manloads over tens of thousands of cycles are required for exploration pressure garments.

Research done in Phase I of these efforts should focus on technical feasibility with an emphasis on hardware development that can be further expanded in a future Phase II award cycle. Phase II products must include a demonstration unit suitable for testing by NASA. Prototyping should be tailored to applications to ongoing HEO Mission Directorate missions and possible collaborative use in both the governmental and commercial manned spaceflight disciplines. Minimum deliverables at the end of Phase I are analysis and/or test reports, with priority given to functional hardware prototypes for further evaluation. Technical maturation plans should be submitted with Phase I submittals, as well as any expected commercial applications both internal and external to the manned spaceflight enterprise.Â Â