

Title: An Approach for Performance Assessments of Extravehicular Activity Gloves

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The Space Suit Assembly (SSA) Development Team at NASA Johnson Space Center has invested heavily in the advancement of rear-entry planetary exploration suit design but largely deferred development of extravehicular activity (EVA) glove designs, and accepted the risk of using the current flight gloves, Phase VI, for unique mission scenarios outside the Space Shuttle and International Space Station (ISS) Program realm of experience. However, as design reference missions mature, the risks of using heritage hardware have highlighted the need for developing robust new glove technologies. To address the technology gap, the NASA Game-Changing Technology group provided start-up funding for the High Performance EVA Glove (HPEG) Project in the spring of 2012. The overarching goal of the HPEG Project is to develop a robust glove design that increases human performance during EVA and creates pathway for future implementation of emergent technologies, with specific aims of increasing pressurized mobility to 60% of barehanded capability, increasing the durability by 100%, and decreasing the potential of gloves to cause injury during use. The HPEG Project focused initial efforts on identifying potential new technologies and benchmarking the performance of current state of the art gloves to identify trends in design and fit leading to establish standards and metrics against which emerging technologies can be assessed at both the component and assembly levels.

The first of the benchmarking tests evaluated the quantitative mobility performance and subjective fit of two sets of prototype EVA gloves developed ILC Dover and David Clark Company as compared to the Phase VI. Both companies were asked to design and fabricate gloves to the same set of NASA provided hand measurements (which corresponded to a single size of Phase VI glove) and focus their efforts on improving mobility in the metacarpal phalangeal and carpometacarpal joints. Four test subjects representing the design-to hand anthropometry completed range of motion, grip/pinch strength, dexterity, and fit evaluations for each glove design in pressurized conditions, with and without thermal micrometeoroid garments (TMG) installed. This paper provides a detailed description of hardware and test methodologies used and lessons learned.