



Space Technology

Game Changing Development

Next Generation Life Support: High Performance EVA Glove

NASA's future missions involve deep space exploration to places where humans have not gone before. This poses many new challenges for which the existing astronaut extravehicular activity (EVA) gloves are not designed. Current gloves are limited to use outside the International Space Station where the environment is relatively pristine and free from the debris and dust present in lunar, planetary and asteroid environments. Thermal conditions may also vary and require different technological approaches to ensure that the astronauts are protected. In addition to environmental differences that may necessitate design changes to the glove, hand injuries are one of the most common injuries that astronauts face. Over the past two decades, gloves have accounted for 47% of all reported injuries. While gloves have been modified over the years to address these issues, they are due for a full redesign.

The objectives of the High Performance EVA Glove task are to develop advanced EVA gloves for future human space exploration missions and generate corresponding standards by which progress may be quantitatively assessed. New technologies and manufacturing techniques will be incorporated into the new gloves to address finger and hand mobility, injury reduction and durability in non-pristine environments.

Three prototypes will be developed, each focusing on different

technological advances. A robotic assist glove will integrate a powered grasping system into the current EVA glove design to reduce astronaut hand fatigue and hand injuries. A mechanical counter pressure (MCP) glove will be developed to further explore the potential of MCP technology and assess its capability for countering the effects of vacuum or low pressure environments on the body by using compression fabrics or materials to apply the necessary pressure. A gas pressurized glove, incorporating new technologies, will be the most flight-like of the three prototypes. Advancements include the development and integration of aerogel insulation, damage sensing components, dust-repellant coatings, and dust tolerant bearings.



Prototype outer glove protective layer.

NASAfacts

The development of quantitative standards and protocols will help standardize the methods by which human-glove performance and injury potential are assessed. These standards will allow the establishment of baseline state-of-the-art glove performance metrics against which HPEG prototypes and future glove development efforts can be measured.

A glove performance testing protocol was developed to enable consistent testing and data collection among the many iterations and variations of prototype designs that occur throughout the development process. The tests include the evaluation of factors such as comfort, dexterity, fatigue, fit, mobility, strength, and tactility.

As glove designs evolve to protect astronauts in new environments, methods for collecting and analyzing data are being created. Thermal properties of materials are evaluated for extreme high and extreme low temperatures at different environmental pressures.

To ensure that the gloves are durable enough to withstand harsher environments, testing is done to determine the effects of dust exposure on glove materials and bearings.

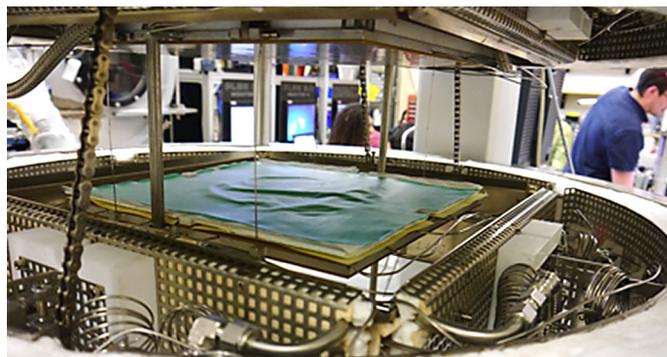
Studies are also being conducted to determine the causes of hand injuries and to elucidate potential solutions. A suite of sensors has been developed and is being used to collect data on the condition of the gloved hand while performing typical astronaut tasks. The results of the tests will provide information that can be used to design gloves that are less likely to cause injury.

At the project's completion, all research and developed standards will be documented to support further development of advanced EVA gloves for human exploration. Prototypes that reach an acceptable level of maturity will be included in integrated tests with the next generation space suit currently being developed by NASA's Human Exploration and Operations Mission Directorate (HEOMD).

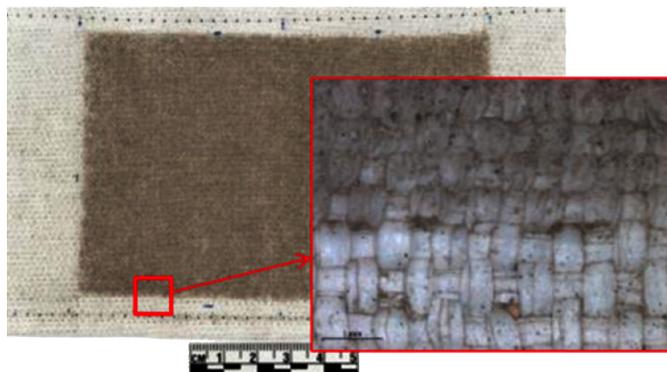
The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare



Knot tying dexterity test.



Thermal testing of a candidate glove layup.



Material abrasion due to lunar simulant (dust) exposure.

them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit <http://gameon.nasa.gov/>

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