

MULTIPURPOSE CREW RESTRAINTS FOR LONG DURATION SPACE FLIGHTS

M. Whitmore,¹ S. Ramsey,¹ G. Finney,² M.R. Ortiz,² V. Byrne,² M. H. Segal¹
¹NASA Johnson Space Center and ²Johnson Engineering

With permanent human presence onboard the International Space Station (ISS), a crew will be living and working in microgravity, interfacing with their physical environment. Without optimum restraints and mobility aids (R&MA's), the crewmembers may be handicapped for performing some of the on-orbit tasks. In addition to weightlessness, the confined nature of a spacecraft environment results in ergonomic challenges such as limited visibility and access to the activity area and may cause prolonged periods of unnatural postures. Thus, determining the right set of human factors requirements and providing an ergonomically designed environment are crucial to astronauts' well-being and productivity.

The purpose of this project is to develop requirements and guidelines, and conceptual designs, for an ergonomically designed multi-purpose crew restraint. In order to achieve this goal, the project would involve development of functional and human factors requirements, design concept prototype development, analytical and computer modeling evaluations of concepts, two sets of microgravity evaluations and preparation of an implementation plan. It is anticipated that developing functional and design requirements for a multi-purpose restraint would facilitate development of optimum ergonomically designed restraints to accommodate the off-nominal but repetitive tasks, and minimize the performance degradation due to lack of optimum setup for onboard task performance. In addition, development of an ergonomically designed restraint concept prototype will allow verification and validation of the requirements defined.

To date a list of interview questions has been developed to identify "unique" tasks and areas of need, determine characteristics of "ideal" restraints, and solicit ideas for restraint and mobility aid concepts. The interview questions will be discussed with a pre-selected group to represent training, safety, crew, human factors, engineering, payload developers, and analog environment representatives. Also, a catalog with existing IVA/EVA restraint and mobility aids has been developed. Other efforts have included coordinating with the Operational Habitability (OpsHab) group to provide debrief data collection of restraints from the Increment 3 crew, compile data from MIR, Skylab and ISS on restraints, and investigate the potential of an in-flight evaluation of current restraint systems.

The next steps involve organizing focus groups to present interview questions and report findings. This will assist in the development of a restraint concept based on previous flight experiences, the needs of future tasks, and crewmembers' preferences. Preliminary schematics will be developed and presented to focus groups for feedback.