From Earth Missions to Deep Space Exploration (05)
Habitation for Exploration Missions (3)

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FACTORS IMPACTING HABITABLE VOLUME REQUIREMENTS FOR LONG DURATION MISSIONS

Abstract

NASA is studying potential long duration (>6 months) human missions beyond Low Earth Orbit (LEO) to establish requirements for technology investment and system development. As part of the study process, assumptions must be made for the volume of the habitable systems required to support these missions. While NASA-STD-3001, Volume 2 (Space Flight Human-System Standard) defines general functional volume requirements and NASA/SP-2010-3407 (Human Integration Design Handbook) provides guidance for determining volume and the factors that must be considered, both are based on studies that do not directly correlate to determining *minimum* volume for *long duration* missions. Due to the length, isolation, and prolonged confinement of these missions, the psychosocial (i.e., refers to both the psychological and the social aspects of living within the confined setting) and environmental factors that impact the crew's perception of adequate space may be amplified. Hence, it was determined that an improved understanding of the relationship between behavioral and psychosocial stressors, potential countermeasures to those stressors, available habitable and net habitable volume, and interior layouts was needed to judge the adequacy of long duration habitat designs. In April 2011, NASA convened a workshop that brought together a multi-disciplinary group of experts from the medical sciences, behavioral sciences, design, human habitability and spaceflight disciplines. This paper presents a summary of the discussion and findings from this workshop, with a particular focus of characterizing these psychosocial stressors and their design implications. The group of experts identified the most salient, design-related stressors anticipated for a long duration exploration mission. The selected stressors were based on scientific evidence, as well as personal experiences from spaceflight and analogs (e.g., Antarctica). The stressors were organized into eight major categories: allocation of space; workspace; general and individual control of environment; sensory deprivation; social monotony; crew composition; physical and medical issues; and contingency readiness. Mitigation strategies for the identified stressors and their subsequent impact to habitat design were identified. Recommendations for future research to address the stressors and mitigating design impacts are presented.