

IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Astronaut Training, Accommodation, and Operations in Space (5)

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EXPERIMENTAL RESEARCH OF TECHNOLOGIES OF COSMONAUT PROFESSIONAL ACTIVITY
CARRIED OUT DURING THE IMPLEMENTATION OF A MANNED EXPEDITION TO MARS

Abstract

During manned expedition to Mars, the crew will have to perform a large set of tasks in order to manage the interplanetary complex and keep it operational, and implement scientific program. The main objectives of space flight to Mars will be associated with the activities of cosmonauts on its surface. This report reviews a number of operations including extravehicular activity (EVA), the use of planetary rovers and other technical means that form the basis of cosmonaut activities on other planets. Methodology for studying cosmonaut professional activities on the planet has been developed in order to assess capabilities of the crews of future missions to perform a number of the most important operations on the planetary surface. The ISS RS crews also conducted ground experiments on simulators. At that, the flight to the ISS was considered as a prototype of the flight to Mars in terms of its duration, the nature of the cosmonauts' onboard activities, work and rest schedule, preventive measures, the influence of negative spaceflight factors and prolonged isolation. The tasks of improving the experimental base to ensure the possibility of conducting subsequent experiments are defined. The base includes the semi-natural simulator facilities for EVA operations, a full-scale planetary rover simulator, as well as a physical prototype of robotic system controlled by a cosmonaut. Research methodology included pre-flight experiments performed by a cosmonaut 1-1.5 months before launch to space and post-flight experiments in the first days after returning to Earth from the ISS. During the experiments, the parameters required for assessing performed activities were registered automatically, psychophysiological data was recorded, medical health monitoring was carried out, and physical capabilities were evaluated using isokinetic dynamometry. Adequacy of the cosmonaut professional activities during experiments was ensured through the use of standard ISS RS equipment. In addition, the conditions of crew activities on the planetary surface were simulated: gravity (created by suspending a cosmonaut in a spacesuit), flexibility of spacesuits, life support system operation, communications, medical monitoring, planetary surface relief, possible trajectories of movement

on a planetary rover, etc. The study included the operations most typical for the corresponding types of cosmonaut professional activities on Mars. The experiments have investigated feasible technologies of performing key operations on the Mars surface. The parameters of the performance quality are presented, which makes it possible to assess the impact of extreme factors on the crew performance as a result of a long-term stay in space.