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# PHYSIOLOGICAL AND TASK LOADING EVALUATION OF CITIZEN ASTRONAUTS PERFORMING SIDE HATCH EGRESS OF AN ORION MOCK-UP AND LIFE RAFT INGRESS

**Abstract**

Orion is a NASA spacecraft in development to transport humans to and from the Moon and Mars. On re-entry, Orion will nominally perform a Stable 1 water landing with the side hatch being the primary exit mode. Following egress, astronauts may be required to ingress a life raft and may be required to perform life support to an injured crewmember. This study evaluated the ability of citizen astronaut candidates (CAC's) to egress an Orion mock-up via the side hatch wearing a commercially available intravehicular activity (IVA) spacesuit, ingress a single-person life raft and perform cardiopulmonary resuscitation (CPR) on a crewmember. 4 male CAC's, aged 22 to 51 were tested. Median anthropometric measures of participants were within the 5th percentile and 95th percentile male stated in NASA-STD-3000. The Orion measured 16.5 feet in diameter, 10 ft 10 inches in height with a habitable volume of 691 cubic feet. The interior was fitted with 4 seats in a configuration similar to Orion. The Final Frontier Design Third Generation (3G) IVA spacesuit was used in this evaluation. There were 4 objectives: 1. Evaluate physiological performance of a suited CAC performing side hatch egress in the Stable 1 position. 2. Evaluate the ability of a suited CAC to ingress a single person life raft. 3. Evaluate workload following side hatch egress. 4. Evaluate tasks loading during all phases of egress and CPR. During egress, heart rate increased by 34.4 beats per minute (11.7) between the recumbent position and accessing the side hatch, increased an additional 9.6 bpm (12.3) between egressing the side hatch and ingressing the life raft and increased again following CPR. Respiration rate increased by 12.7 breaths per minute (7.1) between the recumbent position and gaining access to the side hatch, increased an additional 3.9 breaths per minute (2.4) between egressing the side hatch and ingressing the life raft, and increased again following CPR. Use of a mockup was successful since it enabled egress of the CAC's to be quantified as they completed functional tasks. Egress of recumbent seats provided an opportunity to evaluate techniques used by CAC's to prepare to egress. The 3G suit enabled sufficient range of motion for CAC's to complete tasks despite variation in anthropometry. This research is the first study to assess the performance of a commercially-available IVA suit in post-landing operations.