Abstract

National Aeronautics and Space Administration (NASA) uses exercise countermeasures on the International Space Station (ISS) to maintain crew health and combat the negative effects of long-duration spaceflight on the human body. Most ISS exercise countermeasures system (CMS) equipment rely heavily on the use of textile and wire ropes to transmit resistive loads and provide stability in a microgravity environment. For a variety of reasons, including challenges in simulating microgravity environments for testing and limits on time available for life cycle testing, the textiles and wire ropes have contributed significantly to on-orbit planned and unplanned maintenance time. As a result, continued ground testing and on-orbit experience since the first expedition on the ISS in 2000 provide valuable data and lessons learned in materials selection, applications, and design techniques to increase service life of these ropes.

This paper will present a review of the development and failure history of textile and wire ropes for four exercise countermeasure systems—the Treadmill with Vibration Isolation and Stabilization (TVIS) System, Cycle Ergometer with Vibration Isolation and Stabilization (CEVIS) System, Interim Resistive Exercise Device (IRED), and the Advanced Resistive Exercise Device (ARED)—to identify lessons learned in order to improve future systems. These lessons learned, paired with thorough testing on the ground, offer a forward path towards reduced maintenance time and up-mass for future space missions.