**Multipurpose Cargo Transfer Bags for Reducing Exploration Mission Logistics**
**Abstract**

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The Logistics Reduction (LR) project within the Advanced Exploration Systems (AES) division is tasked with reducing logistical mass and repurposing logistical items. Multipurpose Cargo Transfer Bags (MCTB) have been designed such that they can serve the same purpose as a Cargo Transfer Bag (CTB), the common logistics carrying bag for the International Space Station (ISS). After use as a cargo carrier, a regular CTB becomes trash, whereas the MCTB can be unfolded into a flat panel for reuse. Concepts and potential benefits for various MCTB applications will be discussed including partitions, crew quarters, solar radiation storm shelters, acoustic blankets, and forward osmosis water processing. Acoustic MCTBs are currently in use on ISS to reduce the noise generated by the T2 treadmill, which reaches the hazard limit at high speeds. The development of the AMCTB included identification of keep out zones, acoustic properties, deployment considerations, and structural testing. Features developed for these considerations are applicable to MCTBs for all crew outfitting applications.

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Currently, crew provisions, hardware spares, scientific experiments, and other spaceflight hardware are launched to the International Space Station (ISS) in cargo transfer bags (CTBs). CTBs are available in a range of set sizes, for example, a single CTB has approximate dimensions of 50 cm long x 42 cm wide x 25 cm high. CTBs are also available in half, double, and triple sizes. After use as a cargo carrier, a regular CTB can be used for trash storage, eventually becoming part of the trash itself.

The Advanced Exploration Systems (AES) Logistics Reduction (LR) Project has been investigating ways to use cargo bags for crew outfitting. Multipurpose Cargo Transfer Bags (MCTBs) have been designed such that they are the same size and can serve the same purpose as a Cargo Transfer Bag (CTB). Rather than becoming trash, the MCTB can be unzipped and unfolded into a flat panel for reuse. Concepts include acoustic blankets, solar radiation storm shelters, crew quarters, and water storage/processing. Concepts and potential benefits for various MCTB applications will be discussed.

Recently, two different types of double-sized Acoustic MCTBs were developed. One was designed to be mounted on the outside wall of the Waste and Hygiene Compartment (WHC) cabin, while the other was designed for attachment to the Avionics-2 rack. The designs differ due to the keep out zones of the Avionics-2 rack which has two fire ports and one rack power switch that cannot be covered. Both the WHC cabin wall and the Avionics-2 rack face border the T2 treadmill usage volume. Sound level measurements over the past few years have revealed that the T2 treadmill reaches the noise hazard limit at high speeds when measured at the runner's head location. The purpose of mounting the Acoustic MCTBs on the treadmill's adjacent walls is to absorb noise generated by the treadmill. Material selection was made keeping in mind the acoustic properties of the material as well as the flammability of the assembly. The development of the Acoustic MCTB also included deployment considerations, maintaining cleanliness, and structural testing. Features developed for these considerations are applicable to MCTBs for all crew outfitting applications.

MCTBs have also been considered in the development of a storm shelter concept for the AES Radiation Works (RadWorks) Storm Shelter protection project. A quickly fabricated enclosure was developed called the Reconfigurable Logistics Shelter Concept. This concept was designed to protect four crewmembers during a solar particle event (SPE). In this case, the MCTBs are outfitted with pockets that can hold logistics items such as food, contingency water, wipes, and trash material that can provide radiation protection.

Another future concept for development is crew quarters constructed from MCTBs. Crew quarters provide a personal space for sleep, recreation, communication, and stowage. Currently, Node 2 on ISS holds 4 Crew Quarters (CQs). Each CQ weighs 383 kg and occupies a rack bay. They provide light and visual isolation (privacy), some acoustic isolation, laptop connectivity, display and storage of personal items, and controllable ventilation. MCTB CQs could be designed that would meet a subset of these requirements, while being substantially lighter. MCTB CQs could be planned for a future exploration habitation vehicle, where mass and volume constraints don't allow for full CQs, or MCTB CQs could be used as temporary CQs on ISS as future commercial crew vehicle use increases the onboard need for sleep stations.