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THE PHOBOS LIFE BIOMODULE: A RUGGED, MULTI-SEALED DESIGN FOR SPACE BIOLOGY EXPERIMENTS

Abstract

The Planetary Society's Phobos LIFE (Living Interplanetary Flight Experiment) flew in the failed Phobos Sample Return mission's sample return capsule. The Phobos LIFE experiment was contained in a specially developed, incredibly rugged, multiple sealed "biomodule" designed to safely hold a number of biological samples. This 88-gram biomodule can serve future biological space experiments or other applications where ruggedness and reliability are desired.

Phobos LIFE was to have been a test of one aspect of the "transpermia" hypothesis: the possibility that life can move between nearby planets inside rocks ejected into space by impact events. The biomodule acted as a simulated meteoroid in deep space for nearly three years and was to have experienced the high radiation and microgravity aspects of that trip, while ensuring separation of microbes and containment of microbes even under harsh Earth return conditions.

The LIFE biomodule consists of a titanium outer shell and uses webs and pockets to provide strength at low mass, and a strong, padded, multiple sealed design to provide structural integrity even under accelerations up to 4000 g. It includes several types of redundant seals, and 31 individual Delrin sample containers. Phobos LIFE contained 10 different types of organisms, representing all three domains of life, and one soil sample, but choices of materials could vary in future experiments. The LIFE biomodule is completely passive, allows sealing of individual sample tubes under Argon or other choices of gases, and can accommodate passive temperature and radiation sensors. Many tests were carried out on biomodules to validate the design and performance. These included vibration tests using a shake table, and impact tests using an air cannon which produced impact conditions beyond 4000 g. In multiple impact tests, no leaks in any seals occurred.