

Quantification of spore-forming bacteria carried by dust particles

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An associated risk of space exploration is the potential of forward contamination of extraterrestrial environments with microorganisms originating on Earth. Planetary protection seeks to minimize this risk by identifying and reducing sources of contamination during the spacecraft assembly process. Bacterial endospores are of particular concern because their tolerance to a variety of hostile conditions, which greatly increases their ability to tolerate outer space conditions and reach planetary bodies that may be capable of supporting life. Spore-forming bacteria are ubiquitous in nature. It is generally believed that airborne bacterial spores are transported into and within spacecraft assembly facilities by dust particles. While the diversity and distribution of spore-forming bacteria in these facilities have been studied, the level of bioburden by this mode of transport has not been quantified.

In order to establish a biological contamination transport model for predicting the cross contamination risk during spacecraft assembly and upon landing on Mars, we conducted air and surface sampling in indoor, outdoor, and cleanroom environments to determine the ratio of spore forming bacteria to their dust particle carriers of different sizes. The number of spore forming bacteria was determined from various size groups of particles in a given environment. Our data also confirms the existence of multiple spores on a single particle and spore clumps. This study will help in developing a better bio-contamination transport model, which in turn will help in determining forward contamination risks for future missions.