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AN AIRLOCK CONCEPT TO LIMIT THE BIOLOGICAL CONTAMINATION OF MARS DURING A HUMAN EXPLORATION MISSION

Abstract

Avoiding forward and backward contamination during a human Mars surface mission is essential for preserving the pristine Martian ecosystem and for protecting humans and their terrestrial home. The overarching goal of planetary protection is to reduce the risk of such contamination to acceptable levels. For uncrewed missions, this reduction is achieved through thorough and repeated sterilization of the hardware. For crewed missions, this approach is not viable. Instead, COSPAR's recommendation is to avoid regions where contamination is most likely. Unfortunately, these regions are of highest interest to any scientific mission to Mars.

Contamination during a human mission on Mars can occur in various ways, among them leaks from the life support systems and the EVA suits. Perhaps the largest source of contamination, however, is likely the airlock – the prime interface between the human-inhabited interior of the habitat and the Martian surface. Existing and historical airlocks are poor from a contamination avoidance perspective: They usually reduce the pressure to a certain level with pumps during decompression and vent the rest of the gas to the outside of the vessel, along with any microbes in that gas. Furthermore, human missions have been confined to low Earth orbit for the past 50 years, where suits did not have to be cleaned from any microbial contamination. Consequently, existing airlock concepts would be grossly unfit for a Mars mission, even if they were to be adapted to the different gravity environment.

In this presentation, we therefore propose an airlock concept which (1) comprises a gas management system that avoids venting gases in either direction and (2) includes a system for disinfecting the interior of the airlock during the pressurization/depressurization cycle. Such an airlock would greatly help reduce the risk of contamination during a crewed mission to Mars.