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IMPLEMENTING PLANETARY PROTECTION REQUIREMENTS ON THE EXOMARS DRILL

Abstract

According to the definition given by COSPAR, the ExoMars mission 2018 is classified "Category IVb: Landers that search for Martian life". The main objective of ExoMars is in fact to search for biological evidence of life, past or present, on Mars. This is achieved by analyzing soil samples collected from below the Mars surface, down to two meters depth. The samples are acquired by the Drill installed on the Rover and delivered to the Analytical Laboratory Drawer for analysis.

For Category IVb missions, bioburden and organic contamination control are crucial to success because a) the Mars environment has to be protected from terrestrial biological contamination and b) Mars sample properties have to be preserved from terrestrial contamination to avoid false negative/positive results. Forward contamination (point a) prevention is principally achieved by sterilization of the hardware, i.e. "killing" the terrestrial micro-organisms on the hardware itself. To achieve point b), sterilization is not enough since the ExoMars instruments are aimed at both direct and indirect exobiology, i.e. they search for active (alive) and inactive (dead) forms of life. Thus, all the ExoMars parts and in particular those which can transfer organic and biological contamination to Martian samples shall also be cleaned up to proper cleanliness levels.

These aspects have been translated into requirements both in terms of allowed bioburden and cleanliness levels. Bioburden levels are specified in terms of "number-of-spores-per-square-meter": all the items in contact with Mars samples shall not exceed a bio-burden level of 0.03 spores/m2; for other hardware a bioburden level of 300 spores/m2 is acceptable. Concerning cleanliness, the items in direct contact with Mars samples shall go through to "ultra-cleaning" processeses to avoid disturbances/false negative results at the scientific instruments due to organic contamination; for other parts of the hardware, a "Highly-Sensitive-Visibly-Clean" level allow to meet acceptable level of particulate and molecular contamination, provided that proper HW means are adopted during integration and testing activities to prevent possible recontamination. A mix of design choices (materials, processes, "cleanable" geometries), application of sterilization techniques (mainly DHMR), cleaning/ultra-cleaning techniques and bio-burden assays/controls are being applied on the Drill. These techniques/provisions and the overall approach for the fulfillment of the Planetary Protection requirements will be validated on the Qualification Model of

the Drill, which is being manufactured at the time this abstract has been written. By the time of the Conference, preliminary results will be available and will be presented in the paper.