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Mars Exploration – missions current and future (3A)

Author: Dr. Giuseppe Cataldo
National Aeronautics and Space Administration (NASA), Goddard Space Flight Center, United States

Mr. Lorenz Affentranger
The Netherlands
Mr. John Hall
European Space Agency (ESA/ESTEC), The Netherlands
Dr. Brian Clement
Jet Propulsion Laboratory - California Institute of Technology, United States
Dr. Daniel Glavin
National Aeronautics and Space Administration (NASA), United States
Dr. Bruno Sarli
NASA GSFC, United States
Ms. Christine Szalai
Jet Propulsion Laboratory - California Institute of Technology, United States

THE PLANETARY PROTECTION STRATEGY OF MARS SAMPLE RETURN'S EARTH RETURN ORBITER MISSION

Abstract

The Mars Sample Return campaign aims at bringing back to Earth soil and atmospheric samples from Mars to answer key questions about Mars' biological evolution by means of three flight missions and one ground element. The first mission, Mars 2020, landed on the Red Planet on February 18, 2021 and has to date collected a number of samples through the Perseverance rover. The two subsequent missions aim to recover the sample tubes, launch them into Mars orbit and transport them back to Earth. The ground element would be a facility built specifically to receive and analyze the samples. These three elements are currently in the planning and design stages of development and represent an international effort of NASA, the European Space Agency and many industry partners. The work presented here provides an overview of the planetary protection strategy of the third mission, the ESA-led Earth Return Orbiter (ERO), which hosts the NASA-provided Capture, Containment, and Return System (CCRS). ERO-CCRS would capture the samples previously put in Martian orbit, contain them in redundant containers to ensure that no unsterilized particles are released, and return them to Earth through an entry vehicle. Both NASA and ESA policies address the United Nations' Outer Space Treaty by addressing potential harm from material returned from solar system bodies beyond the Earth-Moon system. In the conduct of Mars Sample Return, the two agencies have agreed to apply approaches consistent with their own standards to campaign elements each provides. Specifically, for forward planetary protection, CCRS is not required to meet specific bioburden requirements as a Category III mission, provided that ERO (1) meets orbital lifetime requirements during orbiter operations and (2) any elements jettisoned at Mars meet orbital lifetime requirements. CCRS is required to be built in ISO-8 or better cleanrooms and, by agreement with ERO, be compatible with direct bioburden verification methods. For backward planetary protection, the overall approach includes building robust, highly reliable systems to prevent inadvertent release of unsterilized Mars material through redundant containment vessels and particle transport analyses. Ongoing work to define verification approaches and quantify containment assurance

levels for specific sample return systems will also be discussed, along with how those data will inform launch approval for ERO-CCRS. The decision to implement Mars Sample Return will not be finalized until NASA's completion of the National Environmental Policy Act (NEPA) process. This document is being made available for information purposes only.