

Materials-Compliant Containers in Preparation for OSIRIS-REx Sample Return

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The Origins, Spectral Interpretation, Resource Identification, and Security–Regolith Explorer (OSIRIS-REx) is a spacecraft that collected samples from near-Earth asteroid Bennu in 2020. NASA is expecting OSIRIS-REx to return about 250 grams of Bennu dust particles and rocky material (regolith) in the Sample Return Capsule landing on September 24, 2023 [1]. This carbonaceous material is predicted to be rich in water and organic compounds that will provide key information on the solar system's genesis [e.g., 2]. The NASA Johnson Space Center (JSC) curation team is preparing to process the returned regolith and flight hardware to support critical scientific investigations worldwide.

Samples and hardware will be processed in nitrogen-purged gloveboxes located in an ISO 5 cleanroom to maintain the collection's pristine condition. All sample and hardware containers, tools, and apparatus that will be exposed to Bennu regolith must be fabricated from a restricted list of well-characterized raw materials to minimize contamination risk to the OSIRIS-REx collection. In many cases, the necessary materials-compliant items are not available and need to be custom-designed to meet contamination control criteria and provide a secure barrier from terrestrial atmosphere during transportation and storage. The custom containers discussed here have been developed by NASA curation engineers and scientists for asteroid regolith and sample return hardware.

Stainless steel Tri-Clamp containers are NASA's prime candidates for pristine sample storage. The Tri-Clamp connection allows for rapid assembly/disassembly while also providing a secure seal and low oxygen ingress rate [3]. With these materials-compliant airtight containers, we can maintain a nitrogen environment with an oxygen concentration of <100 ppm for at least 1 month. During sample extraction, regolith and hardware will be immediately containerized and integrated into these containers for transportation and long-term storage. Developing custom containers is challenging because not only do curation scientists need to be able to secure these different objects easily while working in a restricted glovebox environment, but the design must also adhere to materials-compliant guidelines for each stage of the development process.

The 304 and 316 stainless steel grades [4] are the preferred alloys for these sample containers due to their corrosion resistance, austenitic properties, and autoclavability. It is especially important that the containers and tools do not corrode from repeated exposure to ultrapure water, hydrogen peroxide, and autoclaving temperatures (138°C) — all of which may be part of our cleaning and sterilization procedures.

Witness coupons located on the OSIRIS-REx sample canister and sampling mechanism are part of the assessment materials for contamination knowledge. There are a total of 26 coupons that will need to be divided and containerized. These witness coupons' scientific value is their flight exposure history; therefore, a custom container system will be critical for maintaining their pristine value [5]. In a collaborative effort between curation scientists and engineers, custom containers for witness plates are being designed and developed using various 3D modeling software platforms. The design process involves construction and testing of 3D-printed prototypes to ensure that the containers can be manipulated and sealed in a glovebox environment, which is needed to maintain their value as witnesses.

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References:

- [1] Lauretta, D. S. et al. (2022). Spacecraft sample collection and subsurface excavation of asteroid (101955) Bennu. *Science* 377, 285–291. [2] Simon, A. A. et al. (2020). Widespread carbon-bearing materials on near-Earth asteroid (101955) Bennu. *Science* 370, eabc3522. [3] Snead, C.J. (2022) Hayabusa 2022 Symposium, Abstract P-01 [4] Penn Stainless (2020) 300 series. <https://www.pennstainless.com/resources/product-information/stainless-grades/300-series/> [5] Dworkin, J.P. (2018) OSIRIS-REx Contamination Control Strategy and Implementation. *Space Sci. Rev.* 214, 19.