

Simulant Location Exchange Device (SLED)

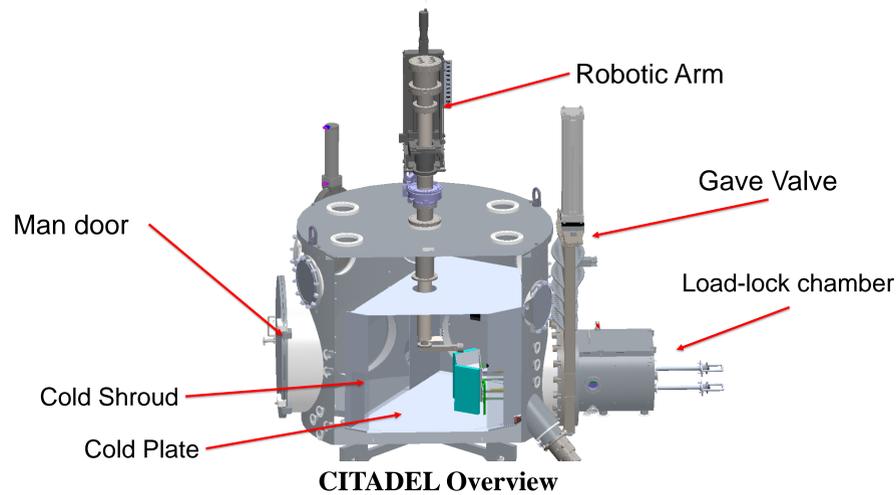
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Objective:

The SLED must move Europa surface simulant into the CITADEL main chamber where it must:

- Maintain thermal contact with the cold plate until desired simulant temperature is reached for testing, and
- Restrain simulant during testing operations, then remove the simulant from the main chamber, all without breaking vacuum or causing significant heat leak.



CITADEL Chamber:

The Cryogenic Ice Transfer, Acquisition Development, and Excavation Laboratory will provide a testing environment which simulates the surface of Europa for sample collection tool development.

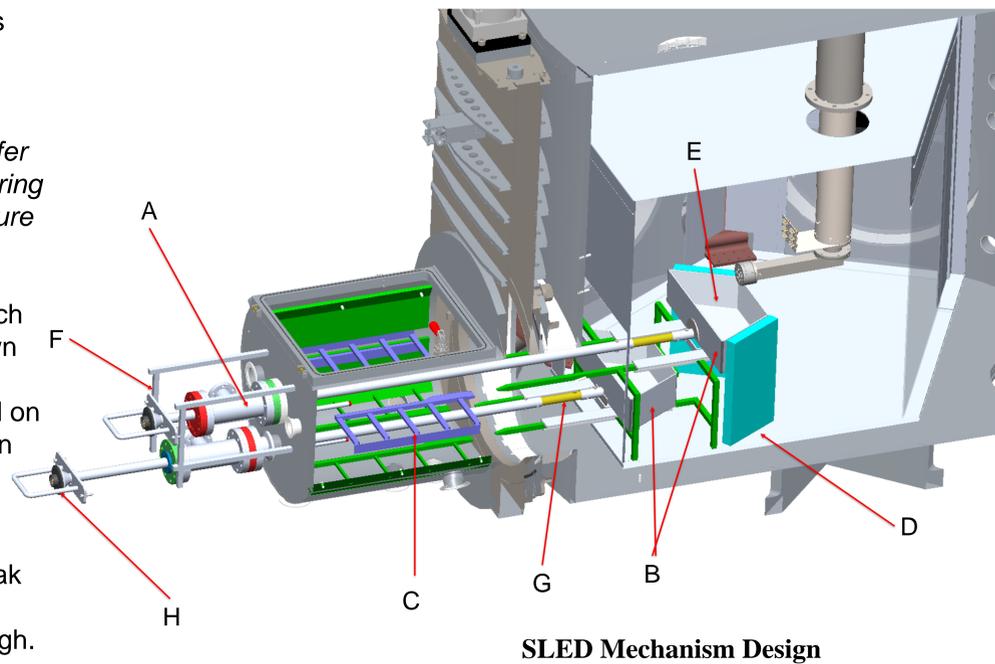
Key features include

- Cryogenic Surface Temperatures: 70–130 K
- High-vacuum (Pressure $<10^{-4}$ Torr)
- Unknown ice composition

We hypothesize that the icy samples generated in this environment will behave very differently from ones generated in an ambient environment. We must also demonstrate that sample collection and handling tools will keep sample temperatures below 150 K, where rapid sublimation occurs at these pressures.

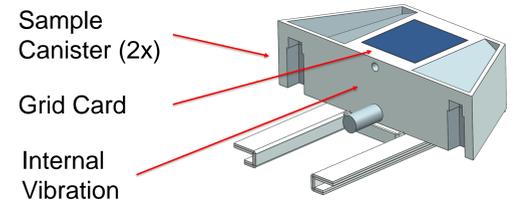
Major Design Features:

- Manually-actuated pushrods which pass through mechanical vacuum feedthroughs known as Wilson seals control the buckets' positions on rails
- Two buckets per load-lock maximize test throughput
 - The decision to use CITADEL primarily for surface-tool development means that a single deep bucket would offer no more value than a single shallow bucket, while requiring more energy (and thus time) to cool to testing temperature
- Top load-lock chamber rails (purple) are removable, allowing the bottom bucket to be loaded
- Buckets are preloaded against aluminum backstops, which provide both a thermal path to the cold plate for cool-down and restraint during cutting operations.
- Trapezoidal bucket shape allows backstops to be located on the sides, providing tool access to bottom bucket between the backstops
- Preload is controlled via a spring-clamp outside the chamber
- G10 extension on pushrod eliminates conductive heat leak into the bucket from the outside
- Pushrod doubles as a vacuum instrumentation feedthrough. Temperature sensors in the buckets will pass through the pushrod, maintaining constant length (no flexure).

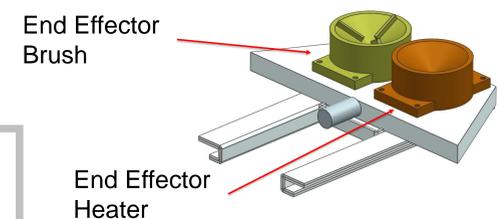


Additional Configurations & Usage:

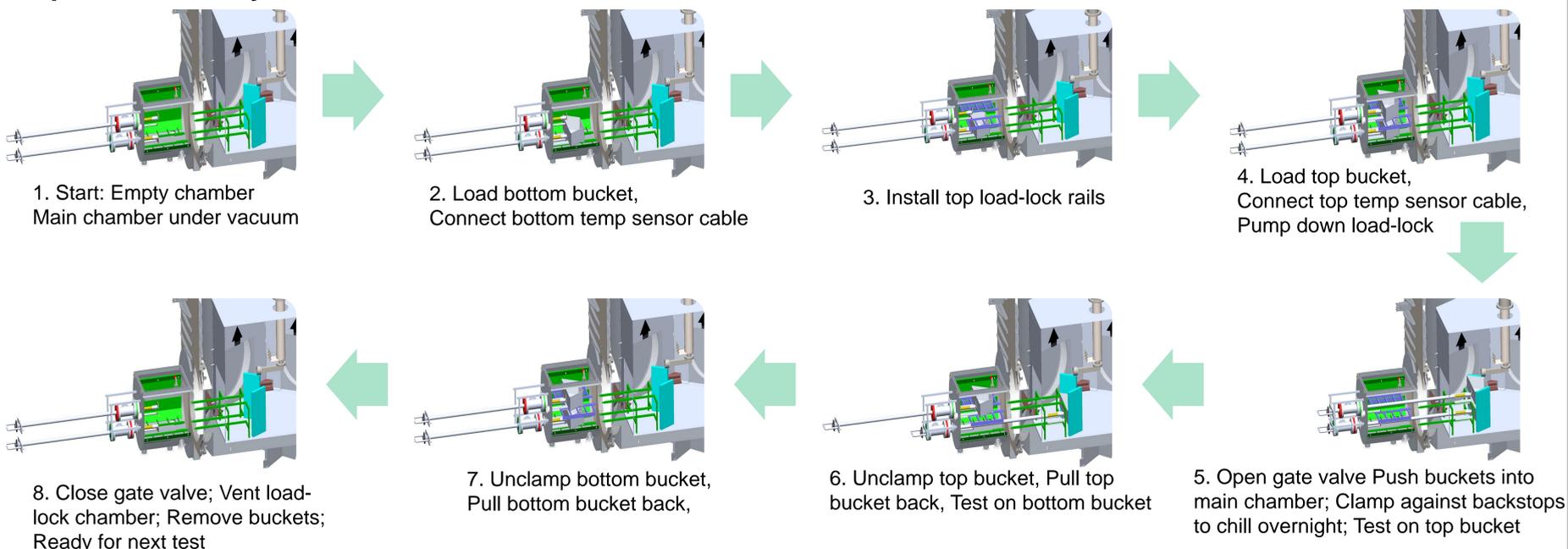
Sample Inspection Station



Tool Reset Station



Operational Storyboard:



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