

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Moon Exploration – Part 3 (2C)

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HYDROSPHERE LUNAR SURFACE SIMULATOR

**Abstract**

The coming decade will see a return to the Moon with robotic systems including sample return missions and human astronauts. This paper presents an enhancement of an existing facility into a lunar surface simulator – a five-meter diameter “dirty vacuum chamber”, unique in Europe, that could serve to perform tests for preparing future lunar missions. Current ESA approach for “Destination Moon” focuses on developing core exploration products for precursor robotic missions: PILOT for landing, PROSPECT for investigating resources and SPECTRUM for communicating. ESA is also cooperating with its international partners on several programs such as ARTEMIS, the LUNAR GATEWAY and HERACLES to perform the coming steps in human and robotic space exploration. The HERACLES (Human-Enabled Robotic Architecture and Capability for Lunar Exploration and Science) mission concept is intended as a key element of the Cornerstone of the European Exploration Envelope Programme (E3P). As such, several on-going phase-0/A studies on system level of the key ESA role in HERACLES – LAE, RGE, LDE, Rover, RLS, ASC, DES and HLS have been undertaken and need to be complemented with associated studies at the subsystem and verification level.

Specific testing capacities need to be developed in Europe in order to test the capability of the elements of HERACLES and ARTEMIS to operate in the harsh lunar surface environment: One of the major constraints for any surface operation is lunar dust. The lunar regolith causes harm to mechanisms, robots and humans. The abrasive nature of the lunar regolith leads to wear and failures in mechanical joints, and the statically charged floating ability of the regolith lets the lunar dust to cover up the surface of optical and other sensitive equipment leading to faulty measurement and equipment overheating as observed in Apollo missions.

Currently there are only few facilities worldwide (none in Europe - large scale dirty DHVAC facility) where lunar dust effects can be tested in a vacuum environment. There exist several vacuum chambers or terrain models such as the coming EAC LUNA facility which can be used for equipment testing either in vacuum condition or on a simulated lunar terrain; but not both.

The HYDROSPHERE Lunar Surface Simulator offers the possibility to simulate lunar surface operations on a medium scale chamber (5m diameter) in vacuum conditions. Together with ESA’s LUNA facility, and other testbeds in Europe, it can increase European capacity to develop and test various items for future lunar surface operations.