

**NASA MSFC Lunar Surface Simulator (LSS): A Facility for Lunar Relevant Environment Testing.** W. E. King<sup>1</sup>, P. Lynn<sup>1</sup>, V. E. Pritchett<sup>1</sup>, and the LSS Team,<sup>1</sup>NASA Marshall Space Flight Center (MSFC), 4600 Rideout Road, Huntsville, AL 35812, United States. (Contact: [walter.e.king@nasa.gov](mailto:walter.e.king@nasa.gov))

**Introduction:** NASA will resume crewed visits to the lunar surface beginning in the mid-2020s. Environmental testing is essential to developing and validating the hardware that will enable a sustained presence on the lunar surface. Lunar dust is one of the most pressing challenges that threatens the longevity of mechanical systems as well as the health of astronauts living and working on the Moon. Facilities that allow large pieces of hardware to be exposed to both lunar dust and the temperature and vacuum of the lunar environment are invaluable to the agency as well as to the broader community of international, academic, and industry partners with which the agency collaborates. Marshall Space Flight Center has outfitted one of its largest test chambers with regolith simulant beds to create the Lunar Surface Simulator (LSS).



Figure 1. LSS Chamber and External Rail System

**Facility:** The LSS is located at the Environmental Testing Facility on MSFC's campus in Huntsville, AL. LSS extends the capability of the existing V20 thermal vacuum chamber (TVAC) maintained and operated by MSFC's Test Laboratory. V20 has supported projects from both internal and external partners, including Orion, ISS, and Space Shuttle.

To facilitate lunar environmental testing, the entrance to the V20 has been shrouded in a negative air pressure tent to contain regolith simulant. A rolling cart rides on external and internal rails to move test articles in and out of the chamber. A high-capacity overhead bridge crane and respirator trained technicians enable test articles to be safely handled.

The LSS complements other dirty chambers available or in development at MSFC such as the Lunar Environment Test System (LETS) [1] and the upcoming Planetary, Lunar, and Asteroid Natural Environment Testbed (PLANET) [2]. LSS also complements the MSFC's Lunar Regolith Terrain Field [3]. These facilities give MSFC partners access to a portfolio of simulated environments that bridge a wide range of scales and fidelities.



Figure 2. LSS Chamber with Regolith Bed Visible

**Capability:** *The V20 Chamber.* The V20 chamber has a diameter of 20ft and a length of 28ft. A LN<sub>2</sub> cryogenic shroud with 13 zones and heat lamps with 9 zones allow temperatures of -180 to 200 Celsius to be achieved. Two high-capacity diffusion pumps enable a hard vacuum of  $1 \times 10^{-6}$  torr to be attained in the chamber.

*The Regolith Beds.* The LSS's rolling cart can support 60,000lbs and a test bed footprint up to 9ft by 20ft. Currently, 9ft by 14ft and 8ft by 4ft beds are operational and available for use. Regolith beds with depths up to 5ft are possible, as long as total weight remains within the capability of the cart.

**Partnership:** The LSS is currently online. Testing activities are managed by the MSFC Test Laboratory. Assistance with regolith simulant selection, acquisition, and preparation is available from the MSFC Materials and Processes Laboratory. Parties interested in utilizing the facility should contact Victor Pritchett ([victor.e.pritchett@nasa.gov](mailto:victor.e.pritchett@nasa.gov)), Patrick Lynn ([patrick.lynn@nasa.gov](mailto:patrick.lynn@nasa.gov)), or Shawn Maynor ([shawn.b.maynor@nasa.gov](mailto:shawn.b.maynor@nasa.gov)) for more information.

**References:** [1] Craven P. et al. (2009) Third Lunar Regolith Simulant Workshop. [2] Hayward E. G. et al. (2022) ISME 15, Topic #14. [3] Summers A. W. and Zanetti M. R. (2022) LSIC Fall Meeting.