

THERMAL VACUUM TEST FACILITY. Thomas Viviano, NASA JSC, Mail Code: EP6, 2101 NASA Parkway, Houston, TX 77058. thomas.v.viviano@nasa.gov

Introduction: There is a need for dusty thermal vacuum test environment derived from Lunar Surface Innovation Initiative (LSII) guidance to demonstrate ISRU oxygen extraction from regolith starting as early as FY22. However, a recent ISRU Strategic Capability Leadership Team (SCLT) review of environment and regolith test capability across the Agency showed a gap in ISRU dusty thermal test capability in the system/subsystem size range.

Lessons learned from human interaction with the lunar surface during the Apollo missions was that lunar dust is difficult to work in and deal with. Testing in lunar surface environments must be of greater focus for future lunar missions. The Energy Systems Test Area (ESTA) at NASA Johnson Space Center is developing a lunar surface environment test bed for ISRU systems and subsystems. An environment where interacting with lunar regolith and dust are extremely important factors in the technology development and demonstration. Current thermal and vacuum capabilities of the JSC B351, 15ft chamber will be augmented with dust and an icy/regolith capability to provide this environment. These capabilities would be geared toward ISRU oxygen extraction from regolith but could easily be utilized for development of other lunar surface systems and dust mitigation techniques.

This work aligns with NASA's lunar mission roadmap as this project seeks to develop the lunar surface environmental test capabilities from Technology Readiness Level 3 (TRL3) to TRL5 or greater to enable use of these capabilities for lunar, and even Mars, exploration missions.

Succinctly stated, the goals of this facility are:

1. Develop an ISRU subsystem & system level test capability for ISRU oxygen extraction from regolith to enable TRL advancement. This would enable the following domains for lunar surface operations testing: Power, ISRU, dust mitigation, robotics, excavation, lunar surface tools, hardware, and the xEMU suit.
2. Provide test bed for dust mitigation techniques and classification efforts.

Thus far, ESTA has developed a dusty lunar environment test capability that includes test system dust mitigation on the 15' TVAC at ESTA for dusty TVAC operations as well as the capability to load a simulant bed for dusty lunar surface operations testing. The dusty environments capability is a dust exposure capability to evaluate the effects of lunar dust on mechanisms, interfaces, and thermal characteristics. This capability will support programs and projects that require a 15' TVAC chamber that can run dirty operations for the purpose of lunar surface systems testing.

This helps close the gap in ISRU dusty thermal test capability in the system/subsystem size range found across the agency by the ISRU Strategic Capability Leadership Team (SCLT) review of environment and regolith test capability.



Figure 1: The 15' TVAC Chamber in Building 351