



Lunar Regolith Management

Technology Exchange Conference
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CONSTELLATION

Regolith - a geologic term coined in 1897 from Greek words meaning a **mantle or blanket of rock**.

- **Lunar Regolith** - **Unsorted collection of lunar particles** of all sizes, ranging from boulders bigger than your house to submicroscopic bits invisible to an optical microscope.
- **Regolith particles** - **fragments of larger particles**, shattered by impact. In some cases, regolith particles are fused agglomerations of other particles, heated and partially melted together by impacts.
- Lunar **Soil** - lunar regolith particles **smaller than one centimeter**.
- Lunar **Dust** - ***newly defined*** as lunar regolith particles **10 μm and smaller**.

**No matter what we call it,
we have to manage it!**

The Apollo Experience: Lessons Learned for Constellation Lunar Dust Management

"I think dust is probably one of our greatest inhibitors to a nominal operation on the Moon. I think we can overcome other physiological or physical or mechanical problems except dust."

*Gene Cernan
Apollo 17 Technical Debrief*



"A common sense, layered, engineering design defense can solve any apparent problem with dust during long-term human activity and habitation in the lunar environment."

*Jack Schmitt
Ames Research Center
February 2, 2004*

Pervasive, Lunar Regolith is ... *

- Surface Obscuration During Descent
- Lunar Module Descent Engine Regolith Transport
- Lunar Module Contamination in Space
- Contamination during Transfer between the LM and CSM
- Command Module Contamination
- Mechanisms for Lunar Module Contamination
- External Environmental Lunar Dust Effects
- Space Suits and Seals
- Human Exposure
- Operations - Crew Efficiency



Lunar Regolith Management Strategy



- Solid Operational Concepts and Engineering Design will lead to a dramatic improvement in managing lunar dust, e.g.,
 - Airlock
 - Improved Seals
 - Abrasion Resistant Materials
 - Cleaning Procedures, etc.

- Targeted Technologies, defined by CxP Risk Management Plan and Technology Insertion Strategy, will fill reliability and performance requirements gaps, e.g.,
 - Cabin Air Management
 - Automated Cleaning Technologies

Primary Objectives We Want to Hear From You!

- Learn Your Best Practices and Standards for Managing Dust
- Learn Your Capabilities and Technologies for Managing Dust
- Learn Your Testing Strategies to Ensure Proper Operation in Dusty Environments



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Secondary Objectives

- Establish Potential Partnerships
- Identify Interested Participants for the Community of Practice

◆ Capability Needs

- Site Preparation – Roads, landing site, construction materials, radiation shielding
 - In-situ microwave sintering
 - Waste recycling
 - Temporary mats
 - Fixative or adhesives
 - Vibration
- Hard and soft goods surface coatings
 - Coatings that attract and/or repel dust
 - Abrasion resistant coatings
 - Strippable coatings
 - Easy don and doff over-garments
- Compressed gas extraction
 - Storage
 - Re-use
 - Cleaning systems

◆ Capability Needs (Continued)

- Automated cleaning systems
 - Electrostatic
 - Magnetic
 - Vacuum
 - HEPA Filtration
 - Self cleaning connectors
- Manual cleaning systems
 - Non-abrasive brushes that remove very small particles
 - Magnetic and or electrostatic wand
- Crew and equipment translation systems
 - Pressurized articulating jet ways
 - Vacuum transfer



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Thank You

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