

**DRAFT**

**DRAFT**

## Lunar Dust Life Support and EVA Systems Splinter

### Presenters

Joe Kosmo	Apollo Suit History and Data
John Lindsay	Dust Pathways – Forensic Engineering
Bill Farrell	Dust Ingress Probability
Sandra Wagner	Apollo Dust Lessons Learned
John Feighery	Dust Management Overview
Rajiv Kohli	Dust Removal Technology

### Outline of Discussion Topics

#### Spacesuits and sample containers

Space Suit and Sample Container Design for dust control:

1. Prevent dust collection and entrapment
2. Materials that prevent adhesion
3. In-suit dust filters for crew protection
4. Abrasive protection and material coatings
5. Design to prevent dust migration
6. Design for dust tolerant seals
7. Removable/disposable outer garments
8. Suit rotary joints
  - a. Prevent dust ingress & avoid entrapment
  - b. Self-cleaning or cleaning capable
  - c. Abrasion protection
  - d. Seal protection
  - e. Design for performance tolerance to dust

Suit connections (hoses and QDs) design for dust control:

1. Prevent dust ingress into connectors & avoid entrapment
2. Cleaning capable
3. Self-cleaning
4. Abrasion protection
5. Seals protection

System design options and considerations for dust removal prior to ingress:

1. EVA “cleaning station”
2. Design for cleaning ease
3. Brushes
4. Magnetic removal
5. Electrostatic removal
6. Sticky paper/tape

# DRAFT

7. Lay down a barrier cloth or “ground cloth”

## Airlock and Ingress Path Design for Dust Control

Design for ease of entry of suited crew vs crawling during Apollo

Additional cleaning and removal inside the airlock:

1. Brushes and/or broom
2. Magnetic and electrostatic removal
3. Sticky paper/materials (tape)
4. Air jets or air shower? (consumable)
5. Retain suits in airlock
6. Suits as crew lock
7. If A/L to crew module hatch, provide positive air flow direction with filters
8. Dust detection on suit and in air
9. Preventing dust ingest into suit after crew doffing
10. “Vibration pad”
11. Separate tools and samples airlock
12. Collection and containment of residue (barrier cloth)

## Suit maintenance and cleaning inside the Airlock/crew module

1. Suit cleaning, external and internal
2. Suit & PLSS maintenance with dust protection
3. Visor cleaning and protection
  - a. Surface coatings
  - b. Removable coatings
  - c. Abrasive protection external and internal

## Crew modules – LSAM, Habitable & Rover (unpressurized & pressurized)

1. Air flow with filtration
2. Positive airflow pattern for mating to CEV
3. Cleaning of sample containers and any suits carried into crew module
4. Personal Hygiene Methods
  - a. Wash bowl, wash cloths & towels (consumables)
  - b. Wipes
  - c. Magnetic cleaning wand
  - d. Sticky paper/tape
5. Dust detection & measurement in cabin air
  1. Breathing limits
  2. Face mask for eyes and breathing filter (odor?)
  3. Prevention of introduction of dust to suits during IVA

# DRAFT

## Lunar dust issues in suit and module designs for discussions

1. Methods to prevent dust from entering habitat modules
2. Suit cleaning & maintenance
3. Protection of seals, quick disconnects, hose connectors
4. Protection and cleaning of optical components:
  - a. Radiators
  - b. Visors
  - c. Lights
  - d. Displays
  - e. Photovoltaic arrays
  - f. Windows
  - g. Peel-off optical coatings
5. Technology to detect and measure dust levels in the atmosphere
6. Dust deposition on surfaces and in materials
7. Electrostatic/magnetic interaction with electrical systems
8. Personal hygiene dust removal
9. Effects of dust on components & suit thermal properties
- 10.

## Need to know or receive:

### From Medical:

1. dust levels with for human exposure time limits

### From Dust basic research community

1. Dust Particle Size distribution
  - a. Air borne in lunar gravity with time profile for different size ranges
  - b. Non-air borne in lunar gravity
2. Adhesive properties
3. Abrasive properties
4. Magnetic & Electrostatic properties
5. Reactive phase
  - a. Materials & atmospheric
  - b. Time to react to an Atmosphere with oxygen and humidity
  - c. Human interaction
  - d.
6. Flammability/dust flash fire risk
7. Dust Simulants for testing
  - a. Identify lunar dust characteristics
  - b. Create simulants to mimic the different characteristics