Lunar Dust Mitigation System

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ABSTRACT

Lunar dust (Regolith) is abrasive, adhesive, and is a health risk for astronaut crews and habitat equipment. Team ARC proposes a lunar dust mitigation system that directs released dust and directs the dust through floor grates and a dual-stage filtration system before being returned as recirculated air. Initial computer aided design, concept selection, and airflow modeling establish the baseline for future prototype testing.

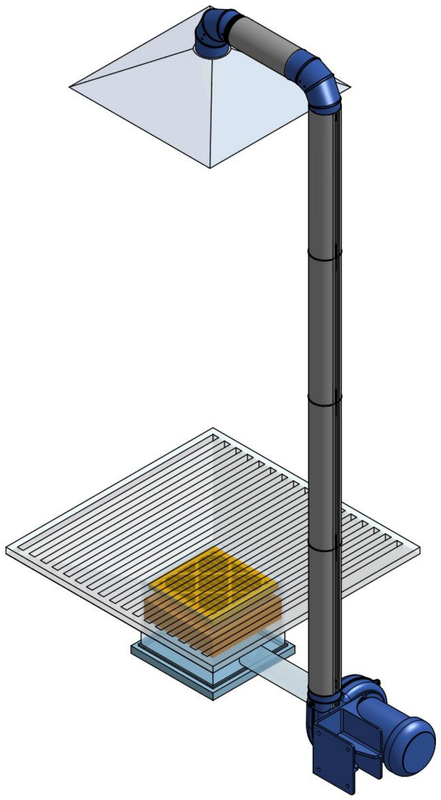
PROJECT BACKGROUND

- Previous Apollo missions demonstrated that lunar dust entered crew modules and equipment
- Regolith can damage seals, damage equipment, clog vents, and be inhaled through the lungs
- TSGC TDC-112 challenge targets a manufacturable lunar dust mitigation system for habitat entry systems

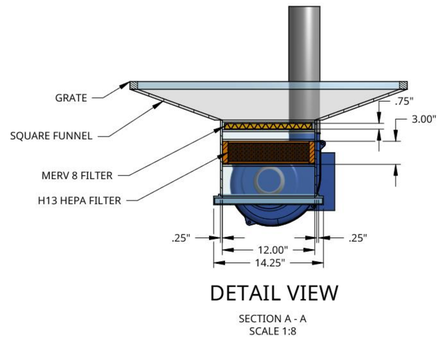
OBJECTIVES

- Remove lunar regolith transfer into habitats by at least 90%
- Use controlled airflow and filtration to capture and contain lunar dust
- Design a safe, reliable system that supports four astronauts within 30 minutes

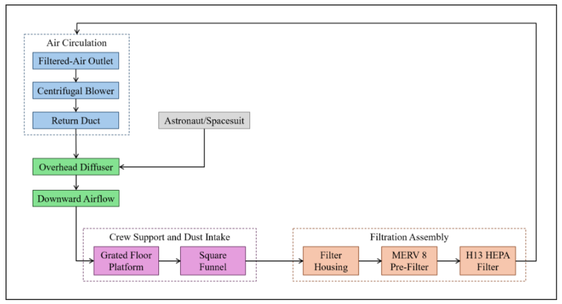
FINAL CONCEPTUAL DESIGN

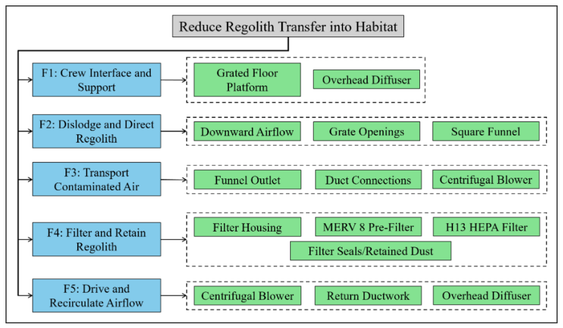


ISOMETRIC VIEW



DETAIL VIEW
SECTION A - A
SCALE 1:8





KEY DESIGN FEATURES

- Directed airflow dust removal
- Two-stage filtration (MERV 8 + H13 HEPA)
- Closed-loop air recirculation
- Modular filter maintenance
- Commercially available components

SYSTEM PERFORMANCE

- Design Airflow: 300 CFM
- Total Pressure Loss: 1.99 in H_2O
- Selected Blower: 1954K52 Centrifugal Blower
- H13 HEPA Filter Dominates Pressure Losses
- Blower Meets Calculated System Requirements

FUTURE WORK

- Fabricate a scaled prototype with a grate, funnel, filter housing, blower and diffuser
- Finalize the airflow and pressure calculations
- Perform dust-transfer test using regolith simulant, and measure the inlet/outlet concentrations and filter pressure drops
- Evaluate suit clearance, maintenance, and vacuum/ thermal durability

CONCLUSIONS

- Team ARC's selected conceptual design of a novel lunar dust mitigation system design provides a baseline for the development of a safe regolith filtration and containment system
- The system architecture and functional decomposition shows the theoretical operation of the lunar dust mitigation system to meet project objectives

ACKNOWLEDGEMENTS

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