

Altair

Lunar Regolith Simulant Workshop



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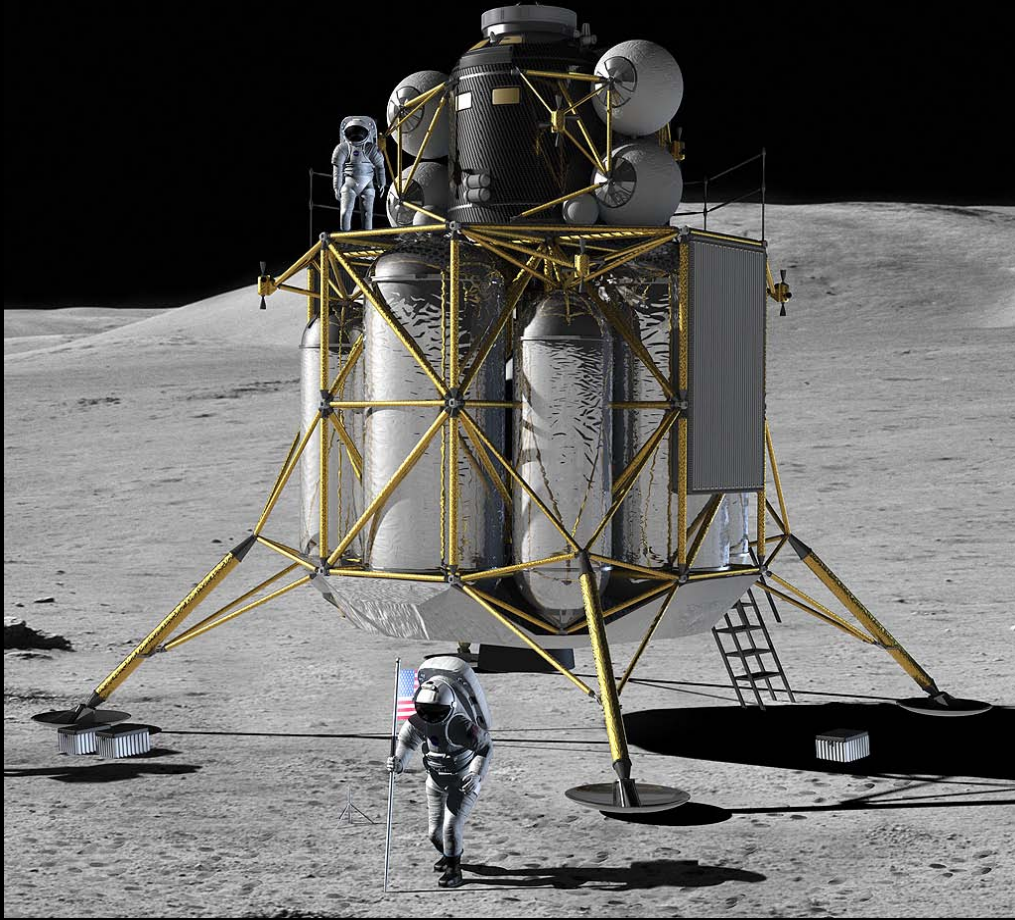
Test & Verification Lead

Altair (Lunar Lander) Project Office

Constellation



ALTAIR: LUNAR LANDER



- 4 crew to and from the surface
- Global access capability
- Anytime return to Earth
- Capability to land cargo
- Descent Stage
- Ascent Stage
- Airlock for surface activities

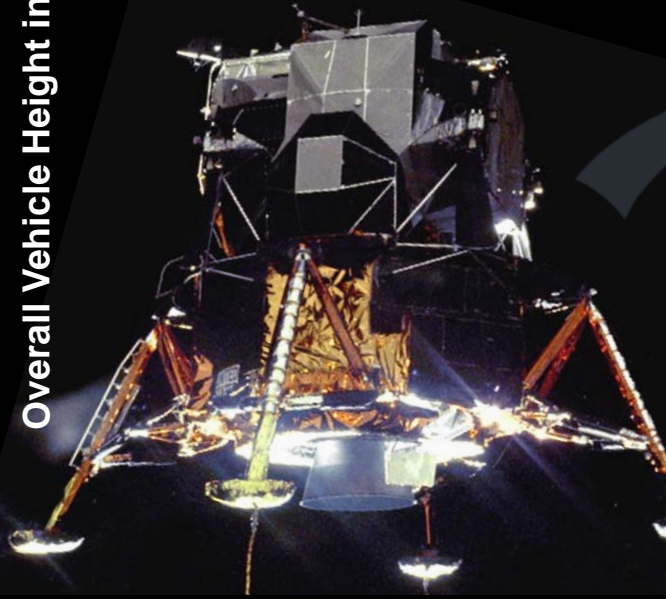
ALTAIR: BUILDING ON APOLLO'S FOUNDATION

10

5

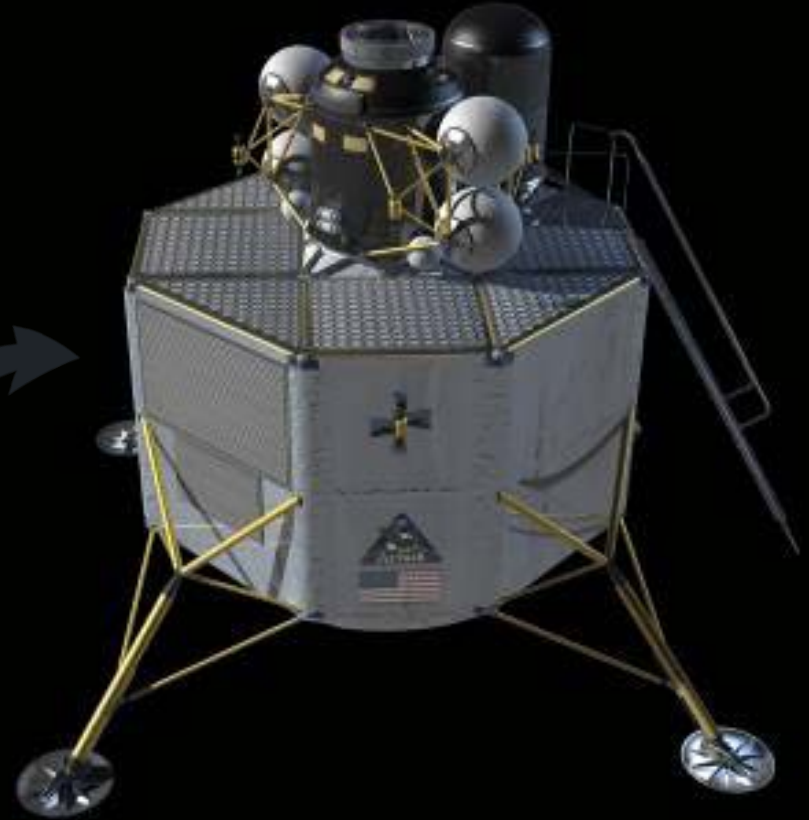
Overall Vehicle Height in Meters

Apollo Lunar Module



Height: 7 m
Diameter: 9 m

Constellation Altair
Lunar Lander



Height: 10 m
Diameter: 15 m

ALTAIR: CONFIGURATION VARIANTS

Sortie Variant

Descent Module
Ascent Module
Airlock

Outpost Variant

Descent Module
Ascent Module

Cargo Variant

Descent Module
Cargo on Upper
Deck

ALTAIR: LUNAR DUST CONCERNS

- **CxIRMA 3389 Lunar Dust Impact for Altair**
 - Integrated dust management requirements are immature
 - Late requirements changes could impact mass, cost, and schedule
- **Potential Issues for Altair**
 - Impaired landing visibility (descent engine/surface interaction)
 - Landing gear interaction with Lunar surface
 - Depress/repress and pressure equalization valve sealing
 - Compatibility with regenerative Life Support subsystem
 - Interference with smoke detectors
 - Surface abrasion/erosion and penetration of seals
 - Degradation of electrical circuits
 - Obstruction/clogging of openings and filters
 - Physical interference/fouling of mating or moving parts
 - Changes to thermal properties
 - Interference with optical characteristics
 - Overheating/fire hazard due to restricted ventilation or cooling

ALTAIR: POSSIBLE LUNAR SIMULANT TESTS

➤ **Integrated System-Level Tests**

- Develop/Evaluate Requirements
 - Develop techniques to quantify dust migration from EVA to Altair
 - Migration from Altair to Orion
- Evaluate dust mitigation strategies, tools, and procedures

➤ **System-Level Tests**

- Dust plume characterization during descent
- Evaluate Altair cabin “Cleanability”
 - Includes cleaning/containing the cleaning tools!
 - Retention & disposal of captured regolith/dust

➤ **Subsystem-Level Tests**

- Life support subsystem compatibility and performance
- Cabin air filtering and smoke detector performance
- Landing gear impact attenuation
- Targeted testing to anchor thermal performance models
- Hatch and valve actuation & sealing evaluations
- Window/display optical performance & cleaning technique evaluations

➤ **Material/Component Tests**

- Component environmental qualification tests

ALTAIR: LUNAR SIMULANT NEEDS

➤ **Quantity Needed: TBD**

- ✓ Potentially very large quantities (hundreds of kg) for dust plume characterizations or full-scale landing gear attenuation tests

➤ **Fidelity Needed: Various**

- ✓ Physical & mechanical properties are important for landing gear or mechanism performance tests
 - Shape, Hardness, Grain size, Density, Shear Strength, Compressive strength
- ✓ Physical & chemical properties are important for life support and thermal performance tests
 - Grain size, permeability, reactivity, composition

➤ **Date Needed:**

- ✓ Development testing >2012
 - Regolith quantity/fidelity needs will be better defined by early 2010
- ✓ Qualification testing >2015

➤ **Special Considerations:**

- ✓ May need to deliver to Prime contractor and/or sub-vendors for component qualification

