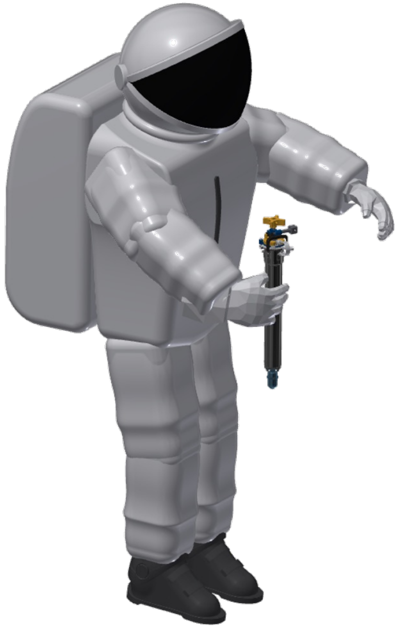
VACUUM SEALABLE CONTAINER (VSC) AND ASTRONAUT LUNAR DRILL (ALD) FOR ARTEMIS



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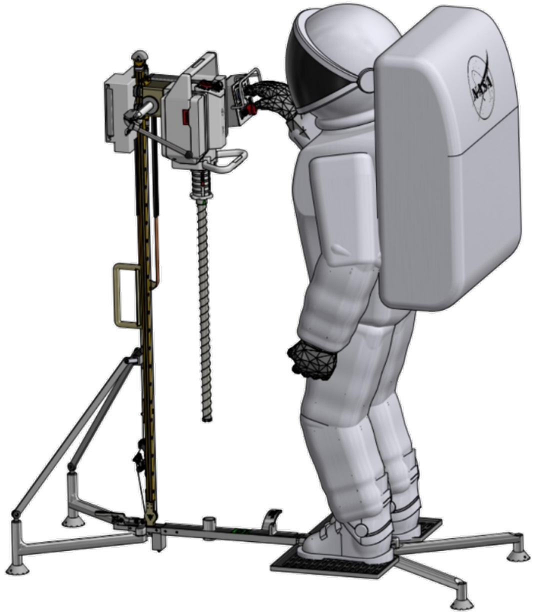
Presented by Leo Stolov



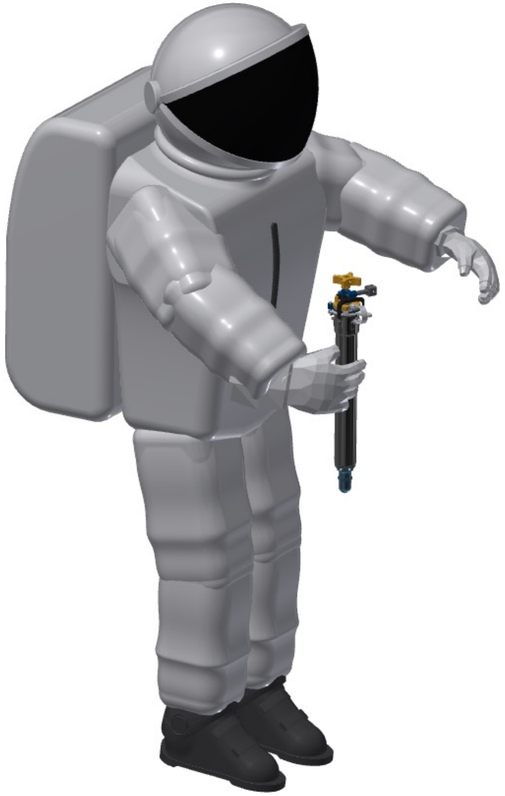
Artemis Program

- Human landing planned for Artemis III and beyond
- Sample return will be key for robust and accurate analysis of composition of lunar south pole
- Sealed core samples recommended in Artemis III Science Definition Team Report

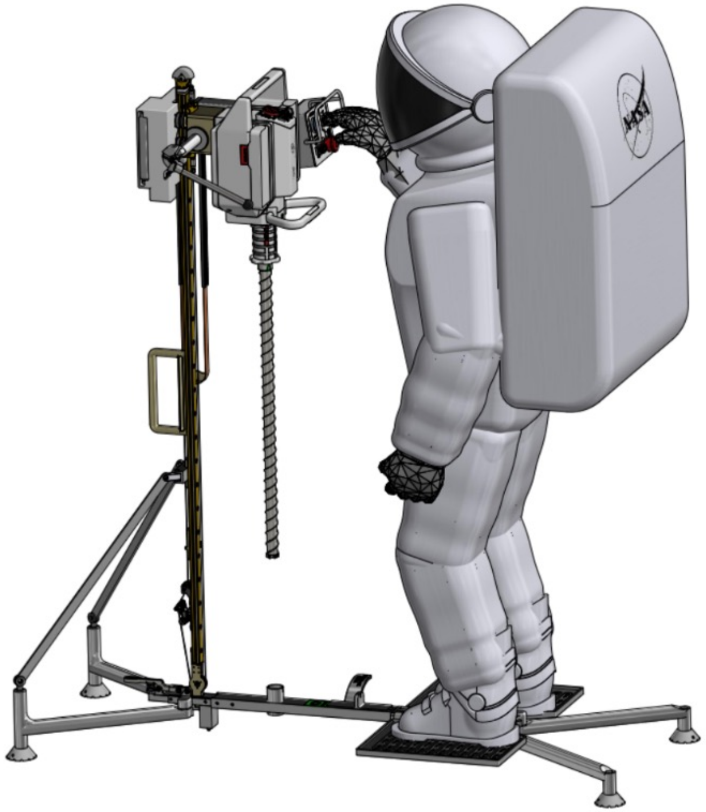
Image Credit: LPI

Sample Return Tools

- Honeybee Robotics, working with NASA JSC, has developed sample return containers and a multipurpose coring drill for Artemis sample return as part of a NASA SBIR Phase III



Vacuum Sealable Container (VSC)
Hermetically seals core samples

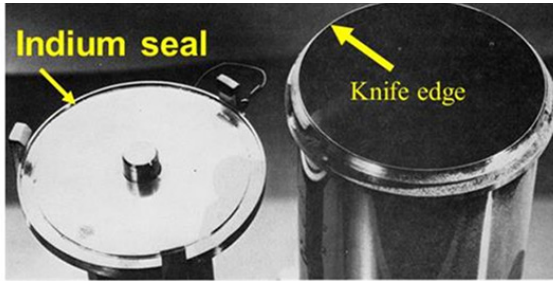


Astronaut Lunar Drill (ALD)
Multipurpose drill to obtains drill cores down to 3 meters

VACUUM SEALABLE CONTAINER

Apollo Sample Containers

- Sealed sample containers used on Apollo
  - Design used knife edge seal actuated by a screw thread



- Lessons learned:
  - Soft indium alloy seal a source of contamination

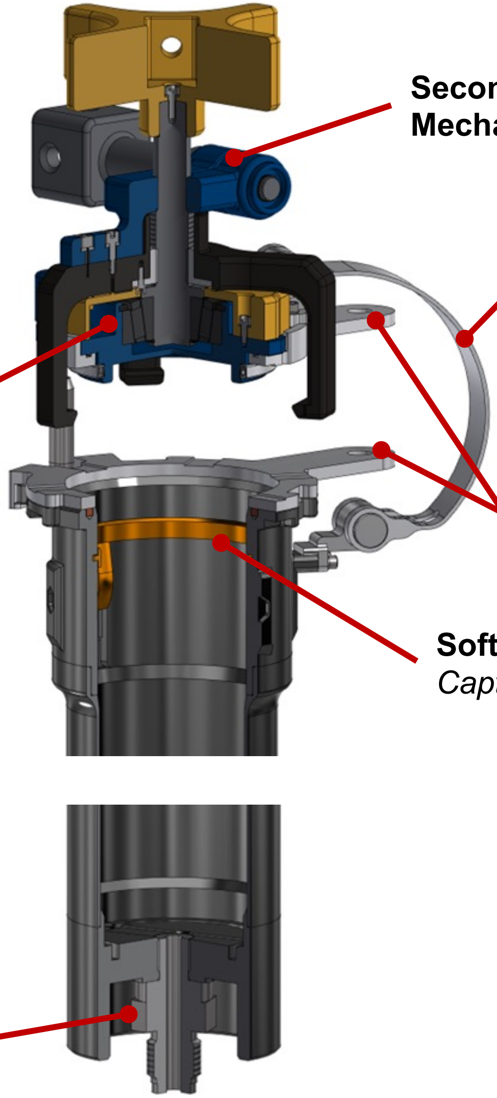
- On lunar south pole: higher volatile content expected in sample
  - Could be harmful to astronauts during sample return

Alan Bean holding the Special Environmental Sample Container (SESC) on Apollo 12

Vacuum Sealable Container – Design for Artemis

HONEYBEE ROBOTICS
Exploration Technology

- VSC hermetically seals core samples
- Designed for internal pressure from volatile content



Vacuum Sealable Container – Simplified Con Ops

HONEYBEE ROBOTICS
Exploration Technology

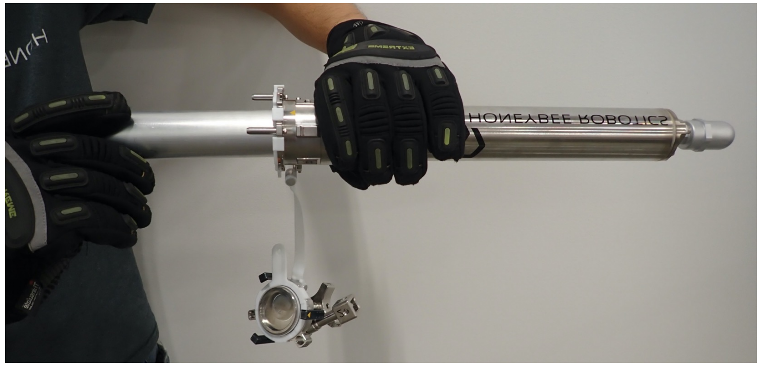
1

Hammer drive tubes into regolith to collect core.

Charlie Duke hammering drive tube on Apollo 16

2

Pull drive tube out and insert into Vacuum Sealable Container.



3

Compress sample with plug inside drive tube.

4

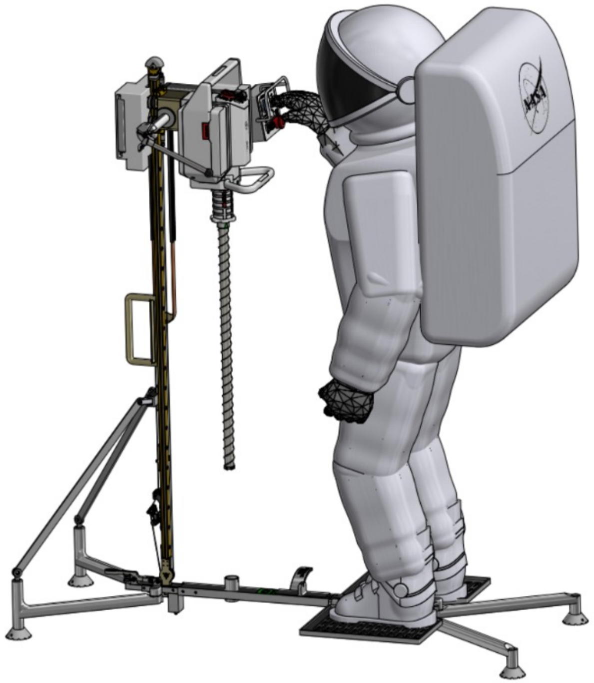
Seal container with lid.

VSC Testing

- Prototypes created to develop VSC design
- Testing included human factors and leak rate

Helium leak rate testing in vacuum chamber

NASA JSC field testing with Vacuum Sealable Container prototype



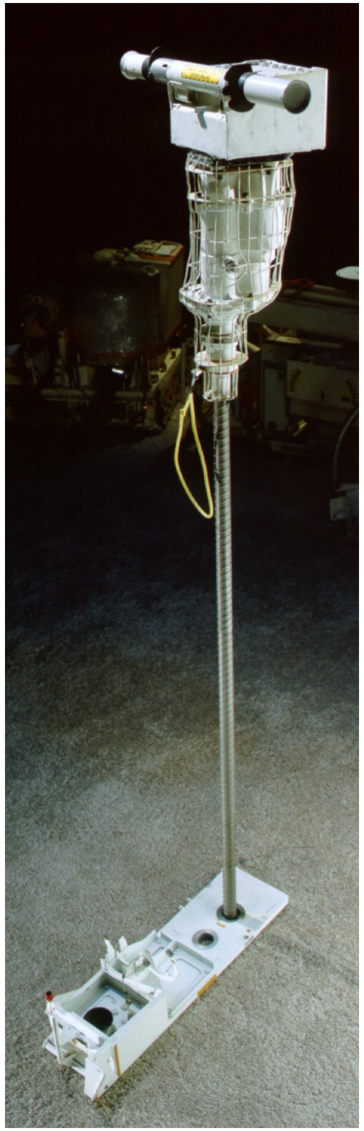
ASTRONAUT LUNAR DRILL

Apollo Lunar Surface Drill (ALSD)

HONEYBEE ROBOTICS
Exploration Technology

- ALSD: Apollo-era, battery powered, rotary percussive coring drill
- Obtained cores at ~3 meter depth

- Lessons learned
  - Labor intensive and time consuming to drill and to pull core out



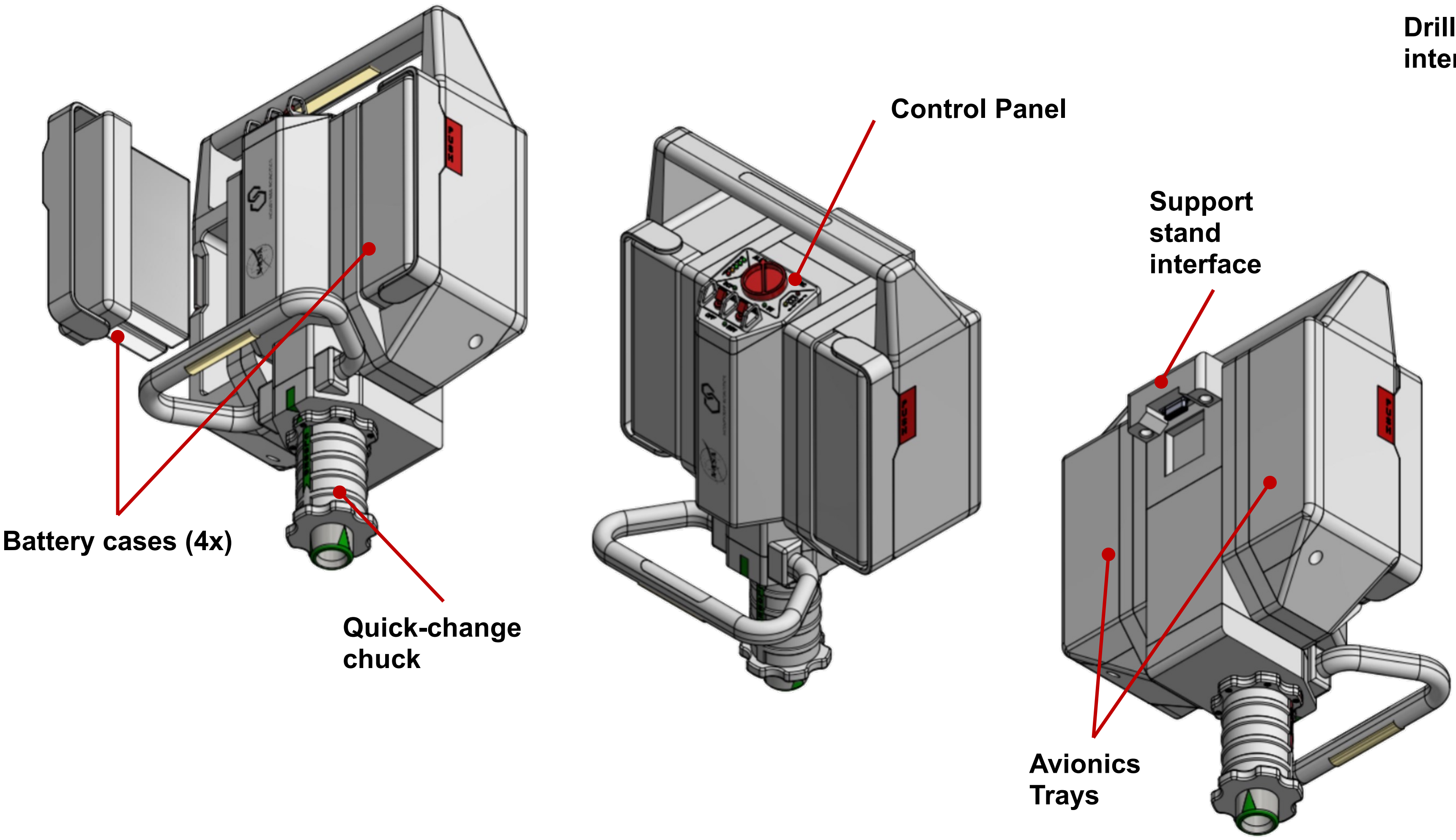
ALSD. Credit: National Air and Space Museum

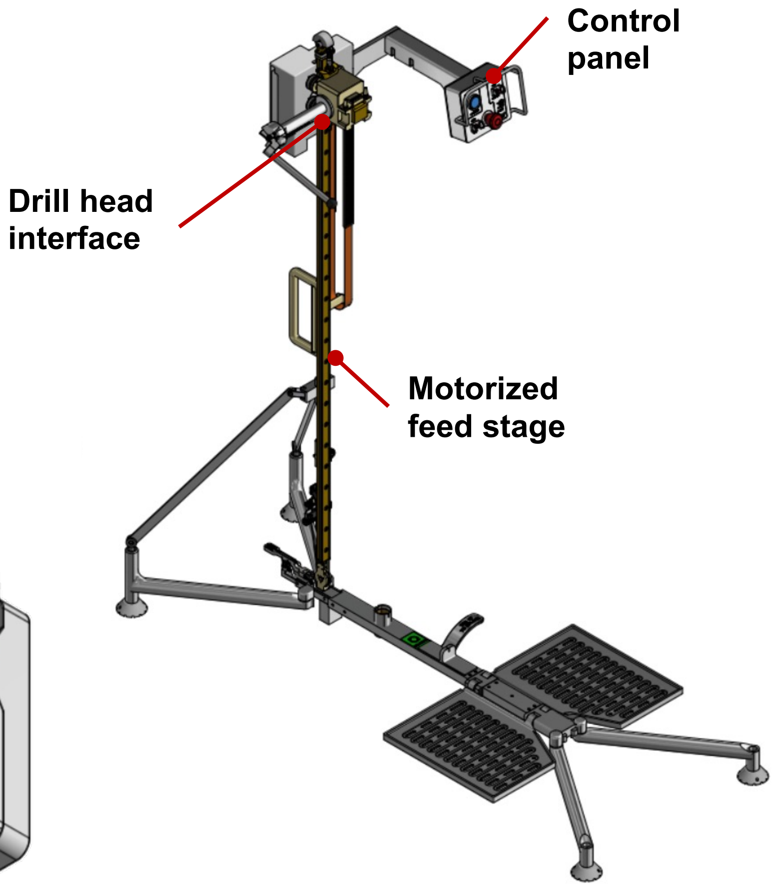
A15: Both astronauts working at the limit to pull up the drill. Severe shoulder sprain in Scott.

A17: Throughout the core drilling and extraction, Gene's heart rate has been over 130 beats, with excursions to 145.

Astronaut Lunar Drill – Design for Artemis

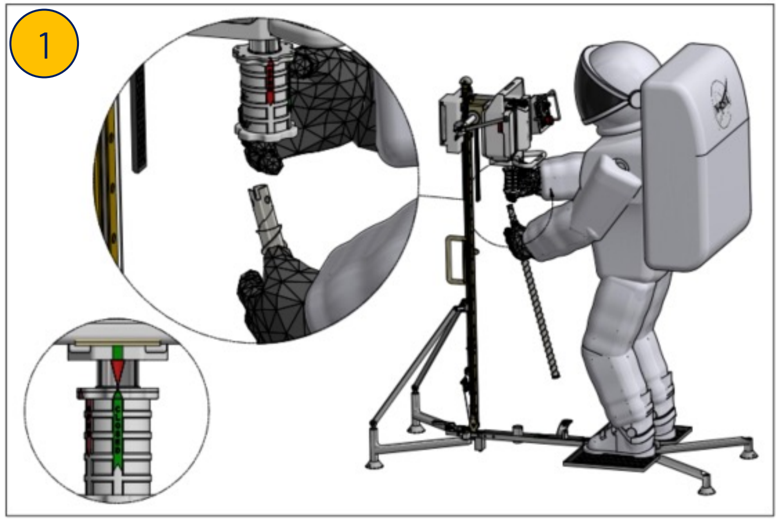
- Dual-axis rotary percussive powerhead
- Support stand with motorized feed stage for drilling and core extraction

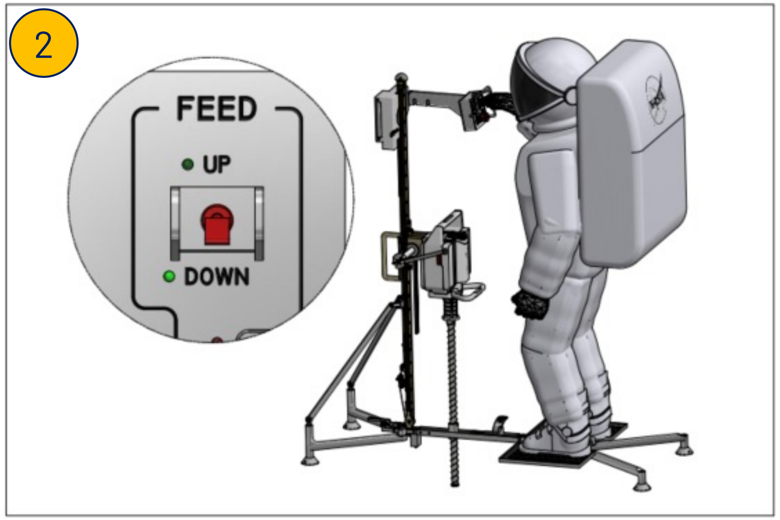


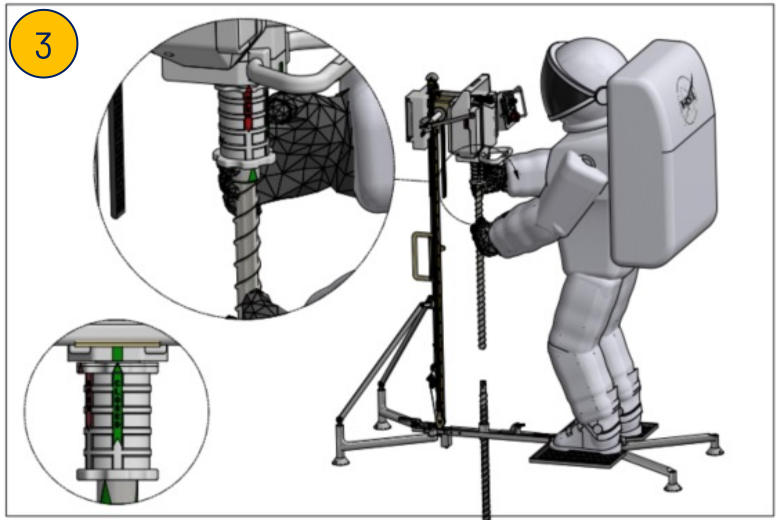


Astronaut Lunar Drill – Simplified Con Ops

HONEYBEE ROBOTICS
Exploration Technology







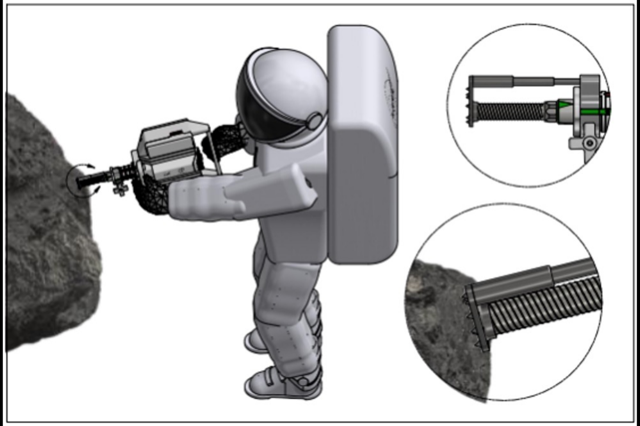
4 **Repeat** steps to assemble drill stem to 3 meter depth

5 **Reverse** steps to dissemble drill stem and extract cores

6 **Seal** drill stems in container

Astronaut Lunar Drill – Additional Capabilities

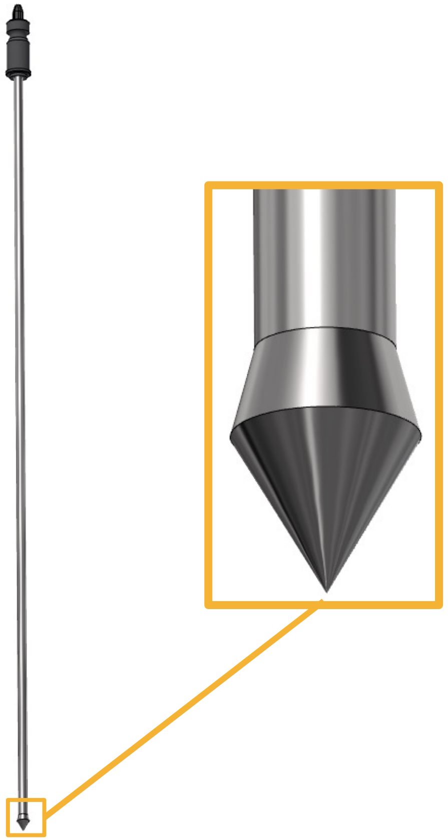
Surface Rock Coring



Surface rock coring bit can be attached to ALD to collect shallow rock cores from boulders.

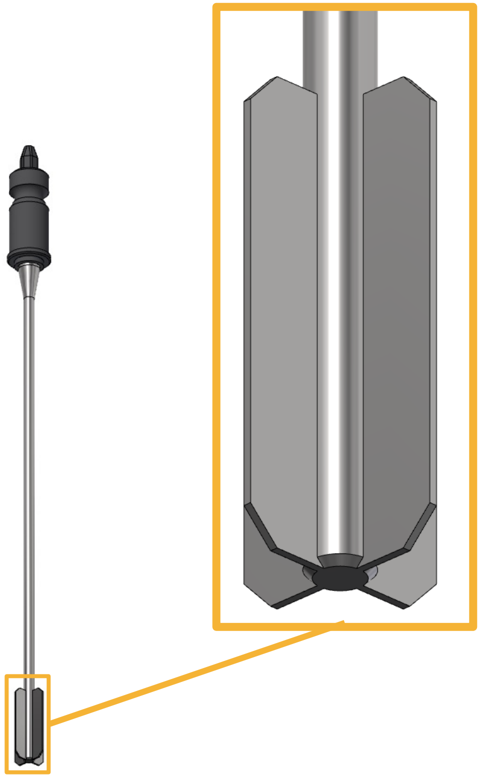
Uses eccentric core break-off technology.

Static Cone Penetrometer



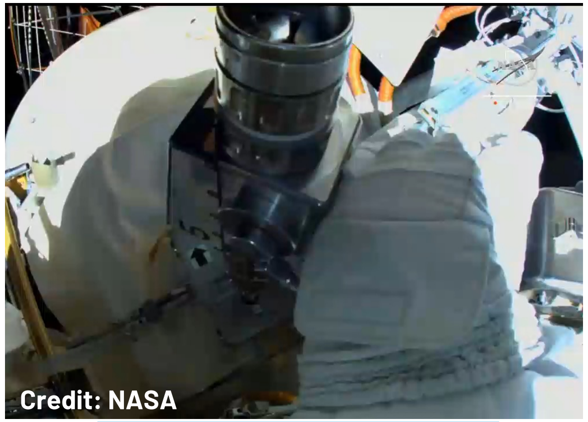
Used to measure regolith bearing strength.

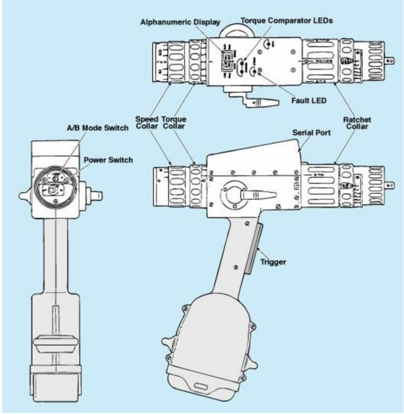
Shear Vane (SV) Rod and Bit



Used to measure regolith shear strength.

Torquing Tool





ALD can be used as torquing tool similar to Piston Grip Tool on ISS.

Astronaut Lunar Drill Testing

- Breadboarding and testing to develop ALD design

Drill stem prototypes for testing

3-meter drill stem testing in lunar simulant

3D printed mockup for human factors testing

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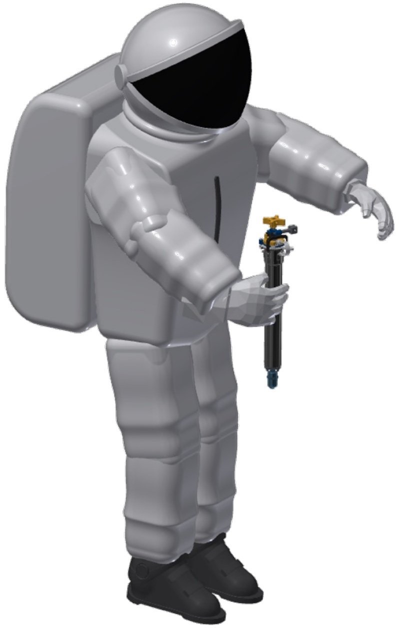
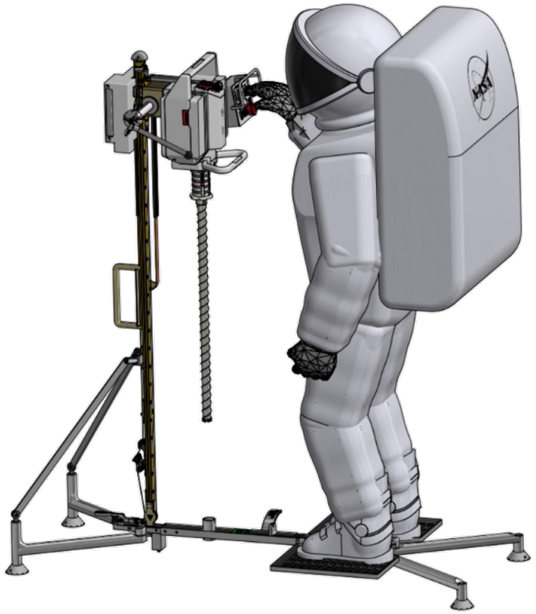
Future work planned under NASA xEVAS program for Artemis III and beyond.





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