MICRO-G NEXT 2016 DESIGN CHALLENGES

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Design Challenges contained in this document are intended for participants in Micro-g NExT.

CHALLENGE: FLOAT SAMPLE GRABBER

NASA Mission Connection

NASA is currently working on systems to take humans beyond Low Earth Orbit to explore the solar system. One of the destinations of interest is an asteroid.

Asteroids are among the solar system's most primitive bodies and are interesting to scientists. A specific sample of interest are loosely adhered surface rocks called float samples. NASA needs a way to collect float samples without cross contamination between worksites.

Objective

Design and manufacture a sample collection and containment device which can mechanically obtain and secure a geology sample from loosely adhered surface rocks in microgravity.

Requirements

1. The device (all parts) shall fit within an 8in x 8in x 18in volume.
2. The device (all parts) shall have a dry weigh less than 15 lbs.
3. The device shall be compatible with a chlorine water environment.
4. The device shall be capture and contain at least one (1) float rock per sample site
5. The device shall provide for collection of samples from three (3) separate sites without cross contamination between sites.
6. The device shall provide for storage of samples independent of one another in order to prevent cross contamination during transportation.
7. The device shall enable visual verification that a sample has been obtained.
8. The device shall be capable of obtaining a sample between 1 and 3 inch diameter.
9. The capturing task shall be accomplished via one-handed operation.
10. The device shall use only manual power.
11. The device may have multiple parts that can attach and detach.
12. The device shall allow ambidextrous operation.
13. The device shall have a tether attachment point 1" in diameter.

CHALLENGE: CORING DEVICE FOR REGOLITH

NASA Mission Connection

NASA is currently working on systems to take humans beyond Low Earth Orbit to explore the solar system. One of the destinations of interest is an asteroid.

Asteroids are among the solar system's most primitive bodies and are interesting to scientists for a number of reasons. A specific sample of interest is a core sample of regolith. Core samples can showcase the history of the asteroid and describe its internal structure.

Objective

Design and manufacture a device that enables an astronaut to obtain a core sample for loose regolith in microgravity.

Requirements

1. The device shall be able to collect a core sample 1" diameter and 6" in depth.
2. The device shall obtain a core from a bin of regolith. The bin will contain a mixture of unconsolidated sand and rock fragments less than 0.25" in diameter.
3. The device shall maintain the stratigraphy of the core during collection, containment, and transportation.
4. The device may be operated manually or under power. Powered operations shall be driven pneumatically.
5. The device may have multiple parts that attach and detach.
6. The device (all parts) shall fit within an 8in x 8in x 18in volume.
7. The device (all parts) shall have a dry weigh less than 15 lbs.
8. The device shall have a tether attachment point 1" in diameter.
9. The device shall be compatible with a chlorine water environment

CHALLENGE: GAP SPANNER BOOM FOR ASTEROID REDIRECT MISSION

NASA Mission Connection

NASA is currently working on systems to take humans beyond Low Earth Orbit to explore the solar system. There are a number of steps NASA has planned on the Journey to Mars. One of those steps is to retrieve a boulder from an asteroid and return it to orbit around the Moon. Crew members will then visit the asteroid to return samples to Earth.

The current architecture has the Orion vehicle docked to the Asteroid Redirect Vehicle (ARV). In order for the crew members to the get to the asteroid, they need to traverse across a gap between Orion and the ARV. It's critical there is a translation path between these two vehicles in order to prevent damage to Orion's delicate thermal protection tiles.

For a visualization of what is needed, please watch the video at this LINK. The device of interest is conceptualized from 1:35 – 1:46.

Objective

Design and manufacture a crew deployable boom and corresponding interface that enables crew translation over this gap.

Requirements

1. You shall design a boom and an ARV Coupler that will attach the boom to the ARV.
2. The crew member shall be able to attach the boom to the ARV Coupler while still inside the Orion vehicle.
3. The boom shall enable translation across a 56" gap.
4. One end of the boom shall have a tether attachment point 1" in diameter.
5. The other end of the boom shall attach to the ARV Coupler.
6. The ARV Coupler shall have a cylinder 1.66" in diameter and 3.5" long that sticks out on one side to attach to the ARV Mockup in the NBL.
7. The boom shall be able to be detached from the interface device while the crew member is in the Orion vehicle.
8. Once attached to the ARV Coupler, the boom shall require no more than 2 actions in order to remove it.
9. The device may have multiple parts that can attach and detach.
10. The device (all parts) shall fit in a volume of 10" x 10" x 18" when in its stowed configuration.
11. The device (all parts) shall fit in a volume of 10" x 10" x 70" when in its deployed configuration.
12. The device (all parts) shall weigh less than 15 lbs.
13. The device shall use only manual power.
14. The device shall be compatible with a chlorine water environment.

CHALLENGE: ANCHORING DEVICE FOR REGOLITH

NASA Mission Connection

NASA is currently working on systems to take humans beyond Low Earth Orbit to explore the solar system. One of the destinations of interest is an asteroid.

The gravity on these small bodies is extremely low, making it challenging to remain on the surface. It is necessary to develop devices that can attach or grip to the surface.

One challenge is that the surfaces of asteroids are not well understood, and can vary from asteroid to asteroid. Is the surface solid or a rubble pile? How thick is the regolith or layer of fine particles on the surface of these bodies?

Objective

Design and manufacture a device that can anchor to regolith in microgravity.

Requirements

1. The device shall be able to anchor to regolith in a bin measuring 1 feet in diameter and 2 feet deep. The bin will contain a mixture of unconsolidated sand and rock fragments less than 0.25” in diameter.
2. The device shall remain anchored in the regolith without the use of an operator.
3. The device shall remain anchored in the regolith when pulled upon by a 10 pound pull force.
4. Mass and volume of the device should be minimized.
5. Depth at which the device goes below the surface should be minimized.
6. The device can be operated manually or under power. Powered operations shall be driven pneumatically.
7. The device may have multiple parts that can attach and detach.
8. The device (all parts) shall fit within a 10” x 10” x 18” volume.
9. The device shall weigh less than 20 lbs.
10. The device shall allow ambidextrous operation.
11. The device shall have a tether attachment point 1” in diameter.
12. The device shall be compatible with a chlorine water environment.

CHALLENGE: ROCK CHIP SAMPLING DEVICE FOR MICROGRAVITY

NASA Mission Connection

NASA is currently working on systems to take humans beyond Low Earth Orbit to explore the solar system. One of the destinations of interest is an asteroid.

Asteroids are among the solar system's most primitive bodies and are interesting to scientists. A specific sample of interest for collection is a 'chip' sample and is defined as a sample which is forcibly removed or broken off from a larger piece of the parent body.

Developing a functional prototype tool to break these samples from the asteroid safely while capturing and containing them for return to Earth is the purpose of this challenge.

Objective

Design and manufacture a device that enables an astronaut to break off and contain 'chip' samples from an asteroid in microgravity.

Requirements

1. The system shall be capable of containing chips approx. 0.5"x 0.5" x 0.5"
2. The system shall be capable of creating chips approx. 0.5"x 0.5" x 0.5"
3. The device shall create, capture, and contain at least one chip per sample site
4. The device shall provide for collection of samples from four (4) separate sites without cross contamination between sites
5. The system shall provide for storage of samples independent of one another in order to prevent cross contamination during transportation.
6. The system shall prevent chipping debris from impacting the crew member.
7. The device shall accommodate rough surfaces.
8. The device shall be capable of obtaining a chip from a range of natural rock densities (specifics to be given at alter time).
9. The device (all parts) shall fit within a 10" x 10" x 16" volume.
10. The device (all parts) shall weigh less than 15 lbs.
11. The device may have multiple parts that attach and detach.
12. The device may be operated manually or under power. Powered operations shall be driven pneumatically.
13. The system shall allow ambidextrous operation.
14. The system shall be compatible with a chlorine water environment
15. The system shall have a tether attachment point 1" in diameter.