Micro-g NExT FAQs

Micro-g Neutral Buoyancy Experiment Design Teams Frequently Asked Questions

Contents

FAQs: General

1. ***What is the Artemis program?***
   The Artemis program is NASA's lunar exploration program which will use innovative new technologies and systems to explore more of the Moon than ever before. To learn more, please visit https://www.nasa.gov/what-is-artemis.

2. ***What is Orion?***
   Orion will serve as the exploration vehicle for the Artemis program. It will carry the crew to space, provide emergency abort capability, sustain astronauts during their mission, and provide a safe re-entry from deep space return velocities. To learn more, please visit https://www.nasa.gov/exploration/systems/orion/index.html.

3. ***Can I submit a design for more than one tool?***
   Each team may submit a proposal for only **one** of the Micro-g NExT challenges.

4. ***Can I participate in Micro-g NExT if I have a green card/am a Legal Permanent Resident or DACA student?***
   Micro-g NExT is currently available to U.S citizens enrolled in U.S institutions of higher learning.

5. ***Can we choose the test week dates?***
   When submitting your proposal, you can indicate your preferred test week from the list of scheduled weeks. We will do our best to accommodate your preferred week, but your first choice is not necessarily guaranteed.

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6. ***How many teams will NASA select to travel to Houston for a test week?***
   The number of teams is not predetermined but rather based on the quality of submitted proposals.

7. ***Can more than one proposal be submitted from the same school?***
   Yes, more than one proposal can be submitted from the same school. However, students may only belong to a single team.

8. ***Can returning teams participate?***
   Returning teams may participate; however, teams may only have 2 returning members.

9. ***Do members who have submitted a proposal, but have not been selected constitute a returning member?***
   No, the requirement only refers to teams that have previously participated on a team that advanced to Phase II of Micro-g NExT.

10. ***Can teams be comprised of students from multiple schools?***
    Absolutely! We encourage collaboration and interdisciplinary teams.

11. ***What expenses does NASA cover?***
    The selection of a team for this opportunity does not include a monetary award to your institution. NASA assumes responsibility for costs involved with prototype testing in the NBL. Each team is responsible for all other costs including travel to Houston and cost of building the prototype.

12. ***Where can I find information about the Neutral Buoyancy Laboratory (NBL)?***
    Information about the NBL can be found at the following link: https://www.nasa.gov/centers/johnson/pdf/167748main_FS_NBL508c.pdf

13. ***Are there hardware requirements and/or standards my team should be aware of before testing in the NBL?***
    Requirements for hardware that will be tested in the Neutral Buoyancy Laboratory (NBL) can be accessed in the NBL Engineering and Safety Requirements document.

14. ***Do I get to dive with my team's prototype during testing in the NBL?***
    Professional NBL divers will test the tools and students will direct the divers from the Test Conductor Room of the NBL facility.

15. ***With whom will my team interface with at NASA?***
    Your team will have multiple interfaces at NASA, each of which serve a different function. Your main interface will be the Micro-g NExT coordinator.

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16. ***The outreach portion of my project involves development of K-12 curriculum for classroom use. Are there any suggested components I need to incorporate?***
    The following websites might be useful when looking to incorporate NASA missions into the curriculum:
    https://www.nasa.gov/stem
    https://www.nasa.gov/stem/nextgenstem/moon_to_mars/mars2020stemtoolkit

    You may consult with a current K-12 educator on this topic. It is suggested that you consider the following:
    - All curricula are aligned to national standards.
    - Each curriculum piece provides the user with a connection between the curricula topic and microgravity, the NBL, or your prototype's potential use in space exploration via an introductory paragraph. This adds relevance to the material.
    - A curriculum incorporates the 5E model to the extent possible.
    - The curricula are written in grade level appropriate language.

17. ***How does my team's design potentially benefit space exploration?***
    NASA is currently working on systems to take humans beyond Low Earth Orbit to explore the solar system. Some of the destinations of interest are the Moon and Mars. As part of NASA's exploration objectives, new tools and procedures are necessary to carry out the upcoming missions.

18. ***Can we coordinate social media outputs about the project with Micro-g NExT?***
    Absolutely. This can be coordinated with the Micro-g NExT coordinator. We may retweet a team's posts. We encourage you to use our hashtag #MicrogNExT.

19. ***If selected, what is the first step?***
    Your team will be invited to attend a 1-hour orientation session with the Micro-g NExT staff. Attendance of this session is required of the faculty advisor and student team. The session is conducted online.

20. ***Who is responsible for writing the procedures that will be used to conduct test in the NBL?***
    Your team is responsible for drafting the diver procedures and coordinating with the assigned Ops Lead to finalize the procedures.

21. ***My choice for faculty advisor is not a U.S. citizen. Is he still able to work with my team?***
    Yes, he can still act as your advisor. However, he will be unable to travel to Houston for the test week. **Any person participating in the Test Week in Houston must be a US citizen.**

22. ***What happens if our CAD file is larger than 10 MB?***
    Your proposal file must be smaller than 10 MB in order to be submitted to the Micro-g NExT website. This is to ensure all proposals can be reviewed properly from the same database. You will submit two separate files – a proposal and a CAD file. Each file has

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a size limit of 10 MB.

23. How much time should I anticipate spending on this project?

Time requirements will vary from team to team. Expect to spend a large portion of your time on design, creation, and outreach. If your team is struggling with time management, please work with your faculty advisor to set a feasible timeline. The workload of this project is comparable to that of a 3-credit hour course.

24. Does a prototype need to be submitted with the proposal?

A prototype is not required to be submitted with the proposal. However, any prototyping you do will add to the quality of your proposal.

25. What is considered outreach?

Outreach may consist of a presentation to a school group, a symposium, or other similar event. You may also incorporate a social media plan in your outreach.

26. How should outreach be documented in the proposal?

Include a description of activities you plan to carryout. The description should include the purpose of the activity, the intended audience, the expected number of participants, and the perceived impact of the activity. It helps to have a letter of support from organizations you plan to work with in your outreach efforts. It is advised that you begin making connections now.

27. Are BS/MS students who have yet to be immersed in graduate courses allowed to compete in this project?

If your academic status is listed as an undergraduate student when we verify with your college/university, you are eligible to participate as a student.

28. When will we hold the outreach component?

Your outreach component can occur prior to test week, but as some outreach components will include testing results, some outreach could occur after your team's test week.

29. If a school submits multiple proposals, does each proposal need a different outreach section?

Yes, each proposal will need its own outreach section.

30. Do we need a signature from the Department Head or any other management individual from our school before submitting the Letter of Intent and/or the Project Proposal?

You do not need a letter of endorsement for the Letter of Intent, but it is a requirement for your team's proposal.

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FAQs: Technical: General

Please visit the EVA Reference Website. It provides a reference you can use when considering your design. You will only be judged on your ability to meet the requirements outlined in the challenges. You are not required to meet the requirements outlined in the website.

1. ***Is there somewhere to get more in detailed specs regarding the NBL (such as density)?***
   The NBL is filled with chlorinated water with a density of approximately 1 g/cm^3.

2. ***What will be the depth of operation in the NBL?***
   Assume a depth of 40ft. That is the maximum depth of the NBL.

3. ***What are the tether attachment point dimensions/specs?***
   See the EVA Reference Website for tether dimensions. Note there is a 1" diameter hole for the tether to be inserted.

4. ***What is the size of an EVA glove?***
   See the EVA Reference Website for glove dimensions. You can also use a ski glove as a reference. It is approximately the same thickness as an EVA glove. Remember that when a space suit glove is pressurized its nominal position will be "hand open" and the astronaut needs to expend energy to close their hand.

5. ***Is water pressure blasting allowed?***
   Yes, air or hydro pressure is allowed. However, it is important to remember the environment where the tool would ultimately operate. In the vacuum of space, water would flash freeze, making any type of water blasting very difficult to impossible. On the other hand, using water pressure blasting to represent a different blasting method that would work in space is legitimate.

6. ***Who would own the intellectual property rights?***
   NASA hopes to potentially utilize some of the ideas that your team puts forward in a future space mission. Therefore, we ask that teams complete a "Statement of Rights" document. See the Proposal Guidelines for specifics regarding this topic.

7. ***May we 3D print parts of the tool?***
   Yes. Though you'll want to consider the loads that your tool will encounter and ensure that the plastics used in the 3D printer can handle those loads.

8. ***Do I have to meet all the requirements?***
   You will be scored based on how many requirements you meet.

9. ***Some requirements are vague. What should I do in this case?***
   Some requirements are purposely vague. We want you to do the research and provide the rationale for why you designed your device the way you did.

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10. ***Can I use a CO_2 canister?***
    For usage in the NBL, no, you cannot use any type of pressurized canister. If your device is pneumatically powered, you will be required to use standard shop air from the NBL which has a maximum of 125psi.

11. ***Is our team allowed to use gun powder or nail guns?***
    They are not strictly forbidden but you will seriously need to consider safety if you choose to implement these types of designs in space. Also, a critical part of this challenge is to be able to test your tool in the NBL. You would have to prove to NASA without any doubt that the device is safe for the operator. In addition, you should consider the vacuum environment of space and how you would implement such a system.

12. ***Can we have detachable parts on the prototypes?***
    Yes. You can have multiple pieces of hardware to accomplish the challenge. All pieces together should fit within the given dimensions.

13. ***Will we have to make a waterproof version of our tool?***
    You will have to make a version of your tool that operates in the NBL. We will work with you to ensure you are using approved materials.

14. ***Will tools need to be able to be used with either hand?***
    This is not a requirement, but NASA does like tools that can be used by both left and right-handed astronauts.

15. ***How strict is the "one hand usage" rule?***
    All requirements are there for a reason. You will be scored based on how many requirements you are successfully able to meet. Also, the one-handed requirement refers only to performing the action of the tool: such as the act of chipping or the act of grabbing. Two hands can be used for setup or tool management.

16. ***Are we able to use magnets for any part of the challenges, just as a small component, not as a whole?***
    Yes, magnets are okay in that capacity.

17. ***Does the prototype have to be built on a 1:1 scale, or can it be smaller?***
    The simulation in the NBL will be full-scale, 1:1. However, doing scale prototypes during the proposal phase is recommended to show the validity of your design.

18. ***How often can the teams ask for technical clarifications? Will all technical clarifications be posted for all teams to see?***
    All questions and their answers will be continuously posted in this FAQ document. Check this document regularly. Ask as many questions as you'd like, we'll get to them as soon as we can.

19. ***What kind of CAD program is best for all of these? SolidWorks or AutoCAD?***
    You can use any CAD program you'd like, or none. A 3D model is not required, though it is recommended as it is easier to understand a design that way.

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20. ***Can you combine the functions of multiple tools together to save cargo space?***
    That's a great thought and an important consideration for space tool development. For the purpose of this activity, we ask you select only one (**1)** challenge.

21. ***Is there any existing equipment, i.e. tool chucks for pneumatic tools, which we could adapt for our tool?***
    Yes, there are. We would highly encourage you to look at Commercial Off the Shelf (COTS) hardware. It will save you money and time to adapt existing hardware to your tool.

22. ***Are there any existing tools or technologies which the astronauts/divers already use that we could implement in our design, which is also available for final testing at the NBL?***
    We will provide tethers and a bag. It is up to you and your team to design the tool. You can look for commercially available products and integrate them into you design though.

23. ***Are vibrations a major consideration for the tool that can be pneumatically powered?***
    I wouldn't say those are a *major* concern, but they are a hazard. You'll have to cover that in your hazard analysis if you are selected. But we don't anticipate any issues. We used several pneumatically powered tools in the past.

24. ***Do the prototype materials need to be NBL and Space approved?***
    For the purpose of the proposal, the minimum requirement is to describe the materials you would use in the NBL. Any additional information you want to provide about what you would do in a legitimate space application would be very valuable as well.

25. ***What is the umbilical cord purpose during testing at the NBL?***
    The umbilical is a power source.

26. ***What is the connector type for the pneumatic air supply? Quick-connect?***
    See Pneumatics Interface Description

27. ***Will we be expected to provide a pressure regulator?***
    No. NASA will provide you with a pressure regulated air supply.

28. ***What are the temperatures our materials need to be able to withstand?***
    The actual testing will occur in the NBL which is about 85°F. So, for this effort of developing a prototype, temperature will not be a major factor. For space application, there is information online that details different temperatures ranges in space.

29. ***Can we use incompressible fluid in the prototype?***
    We ask that you *do not* use hydraulic systems for this round of Micro-g NExT.

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30. Can aerogel be used?

As Aerogel can have different formulas, it will be up to the team to prove that it is safe to use in the water. You'll need to provide the Safety Data Sheet and do testing of your own to show it is safe.

34. Is there a standard connection for attaching and detaching parts?

No. Your team can design whatever connection you'd like.

35. Does the air tank for the pneumatic power count as a device?

No. If you use pneumatic power, you will be provided with only an air hose.

36. Does this have to be automated or will we be able to instruct the divers as to what to do?

For Challenge 1 of 2020 Challenges, the device must be automated. For the remaining challenges, you will have a direct line of communication with the test subject during the duration of your test.

37. Can we have more than two parts as detachments?

Yes.

38. If we have something on our design that fits the requirements, but upon using it, that part may stretch outside of the dimensions given, is that allowed? Or does everything have to stick within the dimensions you gave us?

The dimensional requirement is a stowage requirement. If your tool doesn't fit into that box when stowed, consider making your device in multiple pieces. Also, not meeting one of the requirements does not disqualify you. You just won't get full credit for meeting that requirement.

39. Can our design deviate slightly from proposal drawings to actual day of testing?

Yes. As with all proposals, there may be slight modifications. However, all changes will need to be approved.

40. Can we adapt technology used in other industries for our design?

Absolutely!

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FAQs: Technical: 2021 Challenge Specific

Challenge 1: Orion Crew Safety – Surface Autonomous Vehicle for Emergency Response (SAVER)

1. ***What is the ANGEL beacon?***
   The ANGEL beacon is a new generation of technology (Second Generation Beacon, or SGB) used for locating persons in distress via satellite tracking.

2. ***How do we get the beacon?***
   The NASA SAR Office will provide the crew beacons and crew survival aids for use in this study. The Universities would be required to provide a solution to home in on the beacon 121.5 MHz signal either through purchasing a commercial homer (readily available) or designing their own homer (which some have done with, for example, a raspberry pi).

3. ***How much does the beacon weigh?***
   The beacon weighs 4-5oz. and is based off the PLB 375 sold by ACR Electronics.

4. ***Would it be advantageous for the team or at least some members to attain a HAM Radio operator license?***
   This is not seen as advantageous. Since we are decoding a spread signal, the time used for getting a HAM radio operators license might better be used on other aspects of the project.

5. ***What is a UAV?***
   An UAV is an unmanned aerial vehicle.

6. ***What is the speed range of the UAV when the SAVER is dropped?***
   For testing purposes, the vehicle will not be deployed from an UAV, but dropped from a crane.

7. ***What are the maximum dimensions that the small and medium-size UAV can carry? What are the minimum dimensions allowed for our vehicle?***
   At a minimum, the vehicle should be able to carry all the contents. Research into the specific UAV groups can shed light on dimensions.

8. ***What weight can we expect for the vehicle? We know it needs to be carried by the drone but were looking for a ballpark weight estimation.***
   A Group 1 UAV can carry up to 20 pounds, and a Group 2 up to 55 pounds. A good weight to aim for is 15-30 pounds, but anything in the wider range would meet the requirements.

9. ***What is the total weight we should expect for all materials carried by the SAVER?***
   At minimum it must be able to carry the required survival materials. The maximum weight will depend on your design. Please refer to challenge documents for more detail.

10. ***Are there specified volumes for the contents of the autonomous vehicle?***
    There is no specific volume listed, contents should dictate volume.

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11. ***Will the rescue supplies be provided to us? If so, what are the dimensions and weights for the survival radio, medical kit, optional inflatable raft, and life preserver? If these supplies are not being provided to us, what type of requirements should we look at when selecting supplies?***
    The crew survival aids will be provided to the teams.

12. ***Can the mobility of the SAVER be described a bit more? Does it need to have both marine and land roving capabilities?***
    The intent for the SAVER is that it can be dropped from a UAV into the marine environment only (fresh and saltwater), not on land. Once dropped it would need to surface and "swim" to the person in distress.

13. ***What is the minimum distance that the vehicle needs to travel?***
    Currently there is no minimum distance.

14. ***Will the vehicle operate at night? If so, are there any mandatory requirements for night operations?***
    Please design the vehicle for the testing environment, which is inside of the NBL.

15. ***Does the craft need to feature obstacle avoidance for objects, such as other boats, on the ocean?***
    Please design the vehicle for the testing environment, which is inside of the NBL.

16. ***Are we interested in carrying astronauts or just delivering materials?***
    We are currently looking for solutions that just deliver materials.

17. ***How is the vehicle going to be deployed from the UAV?***
    For testing purposes, the vehicle will not be deployed from an UAV, but dropped from a crane.

18. ***Are we expected to provide a package that would be "shake proof" in order to test the integrity of the joints and or solder points?***
    Whatever electrical/mechanical designs a team comes up with needs to handle the proposed drop load and operational loads during use. A vibration or shock test on their hardware is not necessary, but it needs to be robust enough to withstand a 6-10 foot drop into the water without breaking mechanical/electrical hardware.

19. ***On the guidelines, we noticed that we can use the NBL power outlet and we were confused as to if we could provide our own battery source or if we are required to use the NBL electrical outlet. Can the vehicle be powered by a battery on test day, or are we limited to NBL electrical outlet? If we are allowed a battery, what are the requirements for the battery?***
    Teams are required to use NBL power. However, it would be beneficial to mention in the proposal how the device would run on battery power.

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20. ***Will there be a mount in the NBL on which we'll drop our device?***
    Yes, there will be a crane used to drop your device in the NBL

21. ***What does "unmanned operation" mean?***
    The device must be self-guided via programming to reach the Astronaut in distress via homing device.

22. ***What does "specifics programmed with mission profiles to address specifics to rescue scenarios" mean?***
    This means to begin a search pattern if a 121.5 signal isn't detected, expanding circles, creeping line, etc.

23. ***Will we be provided with mock parameters? Also is there a time constraint in which the device is supposed to reach the astronaut in distress?***
    In general, the mock parameters are those of the NBL, 101ft x 202ft. This was not given by the SAR office.

24. ***Is NASA going to fund us for the material and equipment needed for the project such as the beacon?***
    The NASA SAR Office will provide the crew beacons and crew survival aids for use in this study. The Universities would be required to provide a solution to home in on the beacon 121.5 MHz signal either through purchasing a commercial homer (readily available) or designing their own homer (which some have done with, for example, a raspberry pi).

25. ***What are the maximum dimensions that are allowed for this robot?***
    Mass will be the primary metric for this, with the different classes in the table below (from Wikipedia). A Group 1 or 2 drone can't have a weight higher than 20 lbs (Class 1) or 55 lbs (Class 2). For example, the Scan Eagle has a stated 7.5 lb. payload capability.

UAS Group	Maximum weight (lb) (MGTOW)	Nominal operating altitude (ft)	Speed (kn)	Representative UAS
Group 1	0–20	< 1,200 AGL	100	RQ-11 Raven, WASP,
Group 2	21–55	< 3,500 AGL	< 250	ScanEagle, Flexrotor, SIC5
Group 3	< 1,320	< FL 180		RQ-7B Shadow, RQ-21 Blackjack, Navmar RQ-23 Tigershark, Arcturus-UAV Jump 20, Arcturus T-20, AATI Resolute Eagle, SIC25
Group 4	> 1,320		Any airspeed	MQ-8B Fire Scout, MQ-1A/B Predator, MQ-1C Gray Eagle
Group 5		> FL 180		MQ-9 Reaper, RQ-4 Global Hawk, MQ-4C Triton

26. ***How will the crane drop the SAVER device? Does there need to be a way to attach it to the crane built onto the SAVER (a point to connect to)?***
    The vehicle must be capable of being dropped from a 10-15 foot height into the maritime environment.

27. ***Is there a required speed or distance that the SAVER must achieve?***
    As a desired capability, we'd want a vehicle to have a max speed greater than ~2 m/s which is the max speed of a drifting raft per AS1356, the international standard for open-ocean rafts. In the NBL you'd want to have this speed reduced due to the size limitations. The proposal/analysis should show capability for 2+ m/s speed, and the prototype vehicle should have that "governed" or adjustable for pool testing.

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28. ***What are the total weights of emergency kits, life rafts and the emergence necessaries?***
    This depends on the hardware selected. Some reference masses are:
    -ANGEL beacon (or commercial handheld PLB): ~5oz
    -Medical Kit: 9.6 oz
    -Water: 1L min / 2.5 L max water weight (2.2 lbs – 5.5 lbs) (hint – I'd compromise on the water amount if in a mass crunch and go with 1 liter). This mass is non-inclusive of packaging
    -Life Preserver: This can be a team choice, the NASA LPU is ~2.7 lbs (43.2 oz, but this includes a 5 oz ANGEL beacon). We are ok with a commercial life preserver if it's easy to be done by a survivor. You can find these at sporting stores like Academy (here in Texas).
    -Survival radio: This can be a team choice again, NASA recommends the PRC-112G, but that weighs 27.2 ounces. An alternative is any waterproof radio that can transmit on 121.5/243/282.2 Mhz and/or on Marine Channel 16 to passing ships.
    For a single person raft, the typical weight is around 11 lbs.

29. ***Can you specify which receiver should we use?***
    The team may use commercially available 121.5 MHz homing equipment or develop a unique solution for use with the NASA-provided beacon. The vehicle shall be capable of using existing equipment to detect the ANGEL beacon 121.5 MHz homing signal in order to guide the vehicle toward the beacon.

30. ***When should the vehicle stop before hitting the target?***
    The vehicle should stop approximately 2 feet from the survivor, within reaching distance but not contacting the survivor.

31. ***What is the max payload weight for the device that will be dropped by a UAV?***
    At minimum it must be able to carry the required survival materials. The maximum weight will depend on your design. Please refer to challenge documents for more detail.

32. ***Are there specific materials we are supposed to use or any limits on what types of materials we can use (such as types of epoxy, plastics, metals, rubbers etc.)?*** Please see the Approved Materials list. If there is a material not listed on there, please email jsc-reducedgravity@nasa.gov to request approval.

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Challenge 2: Lunar Surface EVA Operations – Space Suit Attachment Quick Release System

1. ***Is there a location where we can access the utility belt specifications for Challenge II?***
   No because it is not fully designed yet for the xEMU suit. The new graphics in the challenge document should help explain the scope of the interface you are being asked to make.

2. ***Could we see the previous design for the space suit quick release system, that was not dust tolerant?***
   The new graphics in the challenge document show the current designs and how they generally interface.

3. ***How many tools does an astronaut generally take on an EVA?***
   This is still being determined specifically for the Moon, but for this challenge you are only concerned about dealing with one tool.

4. ***What are the rules on using small springs?***
   There are no restrictions on using small springs on your device just design it within the scope of the requirements listed in the challenge document (ex. dust-tolerant, no pinch points)

5. ***Does a camera need to be attached as one of the tools? If so, what are the cameras dimensions?***
   Please refer to the challenge requirements the concentration is not on the EVA tools used but on the interface between the tool and the Utility Belt.

6. ***Will the user always be able to access our device (to do some kind of unlocking process), or is there a possibility that the tool will be big enough that it gets in the way?***
   Yes, the user will always be able to physically access your interface, but they will not always be able to see it. Therefore, it needs to be easy to use. If the tool is large, the interface you design can be attached near the edge or in a way that allows the access you need (this will be addressed for each team in Phase 2 as needed).

7. ***Does the attachment need to be designed to where it may be worn on a location such as on a thigh or forearm restraint?***
   The design of the tool should not be designed for the thigh or the forearm. Remember per the requirement as far as location is concerned the interface piece will be on the EVA Tool itself and the corresponding interface piece that will be on the Utility Belt, which is rigidly attached to the suit at the waist.

8. ***Does the device need to fit into a 2x2x2 cube when all components are fully extended?***
   No, the volume requirement is for the interface in the stowed/attached position.

   Note: the challenge document has been updated and the dimensions are now 4x4x3". We want to see a variety of designs and don't want a team to not submit a proposal because they can't

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meet a super small size requirement.

9. ***Should the device be capable to work with several types of tools that will then get attached to the space suit?***
   Yes, the idea is to put this on all the different types of tools we want to carry on the Utility Belt.

10. ***How many tools are required to be carried?***
    This is still being determined specifically for the Moon, but for this challenge you are only concerned about dealing with one tool.

11. ***Should the device be able to attach to multiple types or a tool specified by NASA?***
    It should be able to attach to an EVA tool specified and provided by NASA. However, the idea is that your interface design would be used on all tools we want to attach to the Utility Belt.

12. ***Are neodymium magnets and adhesives like epoxy permissible in our design?***
    Please see #12 under the requirements of the challenge descriptions.

13. ***In the design of the four-bolt hole pattern if it's on a flat surface of the device, how deep do the holes need to be drilled in or should the holes fit a through hole type configuration?***
    The hole pattern in the challenge document is Free Fit for #10 screws, so they will be thru holes. Assume the EVA tool will have the blind, tapped holes.

14. ***Is there more information about the attachment mechanism to help us better understand the general design?***
    The challenge document now has more information on the ISS bayonet fitting (probe and receptacle). Imagine a hook that goes into a hole.

15. ***There have been requirements in the past for tools that required locking mechanisms. Is that a part of this system?***
    This is not required for this design because there is some gravity on the moon and those requirements mainly pertain to the ISS, but it is not needed for this design.

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Challenge 3: Lunar Surface EVA Operations – Sample Container Dispensing Device

1. ***Does the bag need to remain in constant contact with the device throughout the use cycle (i.e. from dispensing to filling?***
   Yes, the dispenser needs to have the capability to hold the sample bags, allow the crew to open one, and retain it once it's opened to be filled. Crew preference might be to remove the sample bag right after they open it and hold onto it with one hand while filling it, but we want to build in the capability to leave the open bag on the dispenser for filling.

2. ***Are the dimension requirements constant throughout the duration of the mission? (i.e. could we have any sort of mechanical cover or door that would cause the device to exceed the size requirements temporarily while in use and revert to the required dimensions for storage)***
   Yes, that would be acceptable for this challenge.

3. ***Requirement 4 states that "The dispenser shall restrain the sample bags enough to prevent bag damage, deformation, or accidental opening when not in use." Does the "accidental opening" exclude having the bag intentionally pre-open in the design?***
   Yes, it excludes that. Make sure you're considering cross-contamination between sample bags!

4. ***Are we expected to build our own mock-up of the sample bags for prototyping or will they be provided to us?***
   No, you are not. They will be provided for your testing at the NBL.

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Challenge 4: Lunar Surface EVA Operations – Lunar Sample Coring Device

1. ***Are coring bit, stabilizing jig, and containment all one piece or three separate pieces?***
   This will depend on your design. An underwater drill will be provided, and the coring bit should contain the core sample.

2. ***Does the coring bit have to be reusable?***
   Not necessarily, we'll leave it up to your design. We won't be sending an entire drill mechanism to the moon for just one sample, so it would be nice to be able to swap out to take multiple samples.

3. ***How many samples will be collected?***
   The minimum requirement is one. The ability to take multiple samples is an added benefit.

4. ***Is the setup time between samples a concern?***
   This is not a primary concern because the baseline sample collection is one.

5. ***Can the sample be "snapped off" by applying a side load or does it need to be cut from the bottom?***
   The sample can be snapped off but keep in mind the usability of the tool to make the force requirement reasonable for a typical operator.

6. ***Can you please describe the "ideal" process of taking a core sample from the point of attaching a "coring tool" to the drill until the coring tool is detached from the drill?***
   This is part of your team's research. We suggest looking into how current coring devices work.

7. ***What is the purpose of the stabilizing jig? Is it for keeping the coring bit vertical or to prevent horizontal play and skating?***
   The stabilizing jig should keep the drill engaged with the core sample without the astronaut having to control it.

8. ***Should the stabilizing jig keep the drill from rotating the hand of the user?*** Your design will dictate this. There needs to be something that prevents the drill from spinning out on the end.

9. ***What is the power hand drill connector size limit?***
   13mm, (0.512") drill chuck

10. ***What will the range of RPM be for the drill?***
    RPM is adjustable based on device needs, nominally up to 1000 rpm.