2019 Moon to Mars Ice & Prospecting Challenge Q&A Session Questions

For reference: [Design Guidelines and Requirements]

About this year's challenge:

For the third year of this challenge, you'll notice that the title has been updated, and that's because the teams who have competed the past two years have done such a great job that we've decided to make things a little more interesting and add some additional complexity for this year's teams.

For the Moon to Mars Ice and Prospecting challenge, there are two main components:

1. Prospecting on the moon
2. Acquisition of water-ice from Mars

Along with that is a technology demonstration: designing a prototype of your system to be tested here in the Earth environment on the test stations that are described in all of this year's competition documents.

First, we're interested in seeing what teams can do in designing a concept that could be useful for acquiring water on Mars. When we do eventually go to Mars, there is every indication that there will be ways to get water, and if we can do that robotically, that has a huge benefit to the way we would approach human missions to the surface.

We also want to understand exactly how teams would attempt to go through the dirt to get to the ice. In past years, the overburden has just been a large layer of clay and gravel mixture, but we may not have that exact ground truth at every location we go to on Mars, nor if we go prospecting and exploring for resources on the moon. So, we want to see what teams can come up with to manage different types of materials they might encounter on their way to the ice on either the moon or Mars.

With that, we get the two main components of this year's challenge: prospecting on the moon and then, of course, the acquisition of ice from Mars.

Overburden Content

1. Can you give us more info on the properties of the materials included in the overburden such as the aerated concrete? What is the composition of the concrete?
    a. We are not providing any specific details on the properties of the materials included in the overburden, other than what is published on the website:
    "Teams can expect to encounter distinct overburden layers and each of these layers will be made up of material taken from the following list (**note: not all of these materials will be used**):
        i. Dry Sand
        ii. Clay mixed with 20% sand and 10% gravel
        iii. Clay mixed with 20% sand
        iv. Clay mixed with rocky inclusions
        v. Solid/consolidated rock or stone
        vi. Aerated concrete
        vii. Crushed cinder block

    The hardest layer will have an unconfined compressive strength of ~25 MPa"

2. What are the brand names of the materials used in the overburden?
    a. Due to the fact that the competition now includes a prospecting element, we are not providing specifics on any of the overburden materials.

3. What's the maximum thickness of the concrete?
    a. The maximum possible thickness of any one overburden layer will be 25 cm

4. Will the hardest material be a slab over the entire area (concrete slab) or dense collection of material (packed rocks)?
    a. If solid/consolidated rock or stone is used, it will be in slab form.

5. Will clay be the filler material for the overburden layer or will an individual layer just consist of one of the materials specified in the update paper?
    a. Each of the materials listed above is considered a potential overburden material, including the clay. Individual layers could consist of any of those materials.

6. Is there any information provided about grain or particle size and strength of the overbed layers?
    a. No grain or particle sizes are provided. The only information we are providing in regard to strength of the layers is that the unconfined compressive strength of an individual layer is capped at 25 MPa.

7. Will all layers be horizontal, or will there be any dip in the formations? Is the topography of each layer generally flat for the overburden? Will the testbed be homogeneous horizontally?
    a. The layers will be as homogeneously horizontal as possible, but teams can expect occasional minor formation dips that have been accounted for in the established Margins of Error for that layer.

Test Bin Set Up

1. Can we put sensors on the top of the testbed?
    a. Sensors are allowed if they are mechanically deployed (not by human intervention) and the mass/power is included in the overall hardware limits for the competition. Also, if used for determining the Digital Core, a Path-to-Flight for the sensors must be included.

Digital Core

1. Is the digital core due before water is collected?
    a. The digital core does not have to be turned in before water is collected. Teams will be provided with a digital core form/ template at the start of the competition, and it can be turned into any time over the course of the 2-day competition. (It must be turned in by the end of the 6-hour competition time on the last day of the competition).

2. Could you please expand on this statement: ‘Teams will only have one attempt to produce a digital core’?
    a. Teams can work on their digital core as much as is needed within the 2-day competition. However, when they turn over their final digital core form to a judge, that version of the digital core will be deemed the team’s “official digital core” and no additional revisions can be made at a later time.

3. Is the digital core supposed to provide quantitative values for different layers or is the organizing team looking for qualitative information?
    a. Mostly quantitative (see example below).

1. How may layers does your test bed contain (including the ice)? ___7___

2. Using the chart below, estimate the depth of each layer in centimeters.
   Note: *This graphic does not represent the correct number of overburden layers. It is also not drawn to scale.*

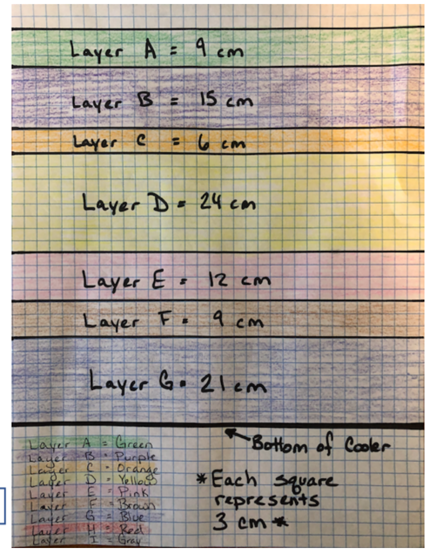
Graphical Depiction of Test Bed *(Not to scale)*

Top of Test Bed

Layer	Depth.	*OPTIONAL* MPa *(for bonus points)*
Layer A =	9 cm	12 MPa
Layer B =	15 cm	15 MPa
Layer C =	6 cm	25 MPa
Layer D =	24 cm	5 MPa
Layer E =	12 cm	2 MPa
Layer F =	9 cm	3 MPa
Layer G =	21 cm	10 MPa
Layer H =	- cm	- MPa
Layer I =	- cm	- MPa

3. Sequence the layers in order of softest to hardest by filling in the boxes below:

E *(softest layer)* → F *(a little harder)* → D *(even harder)* → G → A → B → C → ☐ → ☐



Path-to-Flight

1. Will teams be expected to include design changes of potential water extraction on the lunar surface when writing the Path-To-Flight? And, inversely, what about layer hardness/Digital coring on Mars?
    a. You are not required to describe water extraction on the Moon or coring on Mars; however, if you have room in your final paper, you can describe that as well.

Melting the Ice

1. Are there any limitations on how we melt the ice within the borehole?
    a. We're looking for creative solutions; however, all solutions do have to be approved by LaRC Safety before they are allowed at the competition. For example, no open flames will be allowed.

Project Plans

1. For the project plan document, we need to write about each subsystem including the electronics and control subsystems. What differentiates the electronics subsystem and the control subsystem?
    a. This should probably be "electrical and control subsystems" instead of "electronics and control subsystems". The electrical distribution, motors, and protection comprise the electrical subsystem and the control subsystem is the how the machine operation is controlled (inputs, outputs, and software).

Questions Received During the Q&A Session

1. Will all the test beds be prepared the same?
    a. Each bin will be identical for every team.

2. Will we get a new test bed on each day of the competition?
    a. No. You will have the same test bed throughout the competition. However, the boxes are extremely well insulated to prevent melting.

3. In 2018, one of the teams had an issue with the cooler leaking. Will that be a problem in 2019?

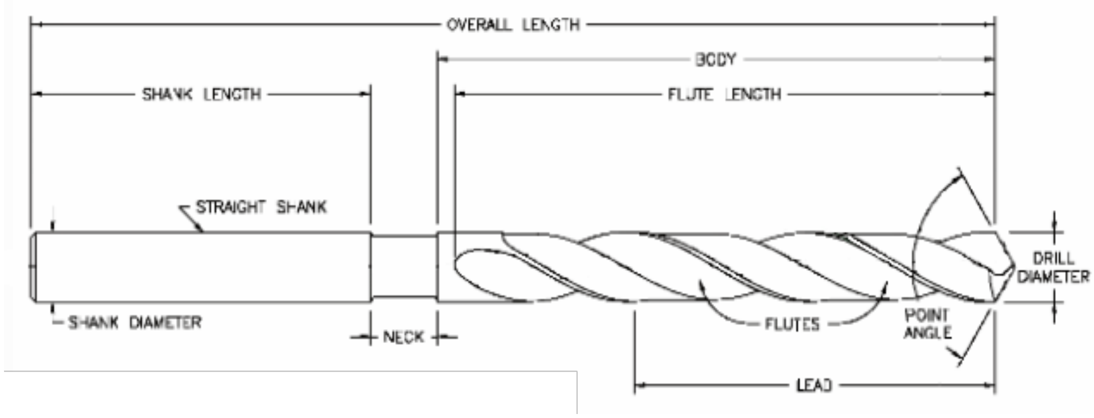
a. No. We have addressed the problem by sealing the drain, adding additional dry ice, and strategically placing the dry ice near the drain (so water would freeze and block the drain before escaping).

4. Does the ice consist of 1 solid block, or 2 separate blocks?
    a. The ice will be 2 blocks fused together. (The blocks are laid horizontally, one on top of the other).

5. Are there air pockets between ice and the surrounding container?
    a. The ice is placed directly inside the cooler, and rests against the bottom of the cooler. Thick Styrofoam surrounds the ice. Between the cooler walls and the Styrofoam, bags of packing peanuts and dry ice are placed for additional insulation. The 2018 Test Bed Packing Instructions are available on the Resources page (#18 under "Recommended Reading). The 2019 box will be insulated in the same way (with extra dry ice and different overburden content).

6. In regard to misalignment, what counts as "too big of a change" between the mid-project review and the final system?
    a. Small changes are fine -- and expected -- as issues come up during integration and testing. We will want to see the reasonings for these small changes in your technical paper. We don't want to see big design changes (for example, bringing an auger system to the onsite challenge when the team proposed a coring system).
7. Is there a team size limit?
    a. There is no limit to the number of participants who can work on the project. However, the onsite portion of the challenge is limited to 5 students and 1 faculty advisor for badging and escort reasons, as well as a limitation on meeting facility space.

8. Is use of radar technology allowed?
    a. This question will be posted as a separate entry on the FAQ's page soon - It is currently being discussed with NASA Safety and the Hangar Facility personnel.
9. The rules limit the length of a drill bit to 39". Does that include the entire length, or just the body?
    a. We prefer you keep the entire drill length (shank, neck, and body) to 39" to prevent bottoming out and accidentally drilling through the bottom of the cooler.



10. In reference to the digital core: What constitutes touching the layers?
    a. The purpose of the Moon to Mars Ice & Prospecting Challenge is to study and test what capabilities might work off-world. Move forward with that assumption in mind and create a ConOps that is feasible. It would be hard for us to list all of the things you CANNOT do. It is okay for any part of your system to "touch" the layers. But it would not be okay for your hand to touch the layers to determine hardness, for example.