

# Artemis Lunar Sample Container

- When Apollo astronauts landed on the moon, they brought lots of rocks back from the moon. All of the rocks were packed in specially designed aluminum boxes (Apollo Lunar Sample Return Case—ALSRC) that were intended to keep air from getting into the box and contaminate the samples. Scientists want to know what kind of micro amounts of gasses might be in the samples (oxygen, helium, water,...). Unfortunately all the boxes leaked letting air get into the boxes and around the regolith and rock samples.
- For the Artemis missions, astronauts will be picking up samples from the south pole area of the moon so scientists expect the samples to have some similarities but still be very different. This time they would like the sample to come back to Earth without being contaminated by the air. What kind of boxes will they be. Can you help design the next Lunar Sample Container?
- Design, build and test a box to contain lunar rock samples collected on the moon but do not allow air to penetrate into the box or let any evaporating gasses or moisture escape the box.
- Big enough to hold two baseball sized rocks.
- Light weight
- Lunar environment
  - cold(-250 F in the shade)
  - hot (+250 F in the sun)
  - dusty (sunlight removes electrons from the dust and static electric forces shift the dust as the sun rises and sets)
    - The dust is very fine particulate that is more like glass shards than rounded dust particles on Earth—the moon doesn't have air or water so the particles are never rolled around but only broken by more meteorites.
- Able to be opened and closed easily with big gloves on.
- Easy to carry with big gloves on



Apollo astronaut training with Apollo Lunar Sample Case





Woven  
steel  
cushion

Plastic bags  
with dirt  
samples



Cushion  
material for  
rocks



Lip that blade fits into



- The Apollo lunar sample box has an orange colored Viton gasket on the lid and body. There is also a metal lip on the bottom and a metal blade on the top that fits into the metal lip.
- The box has 2 clamps on the lid that rotate down to pull the top and bottom together.
- There is a rotating latch that drives two pins (left and right) to lock the box into a rack to keep the box from shifting around during launch when they leave to go back to Earth.
- There are different lining materials to keep the rocks from rattling around in the box. Looks like some woven steel wool for some kind of cushioner then some cloth for containment of the particles.

Viton gasket

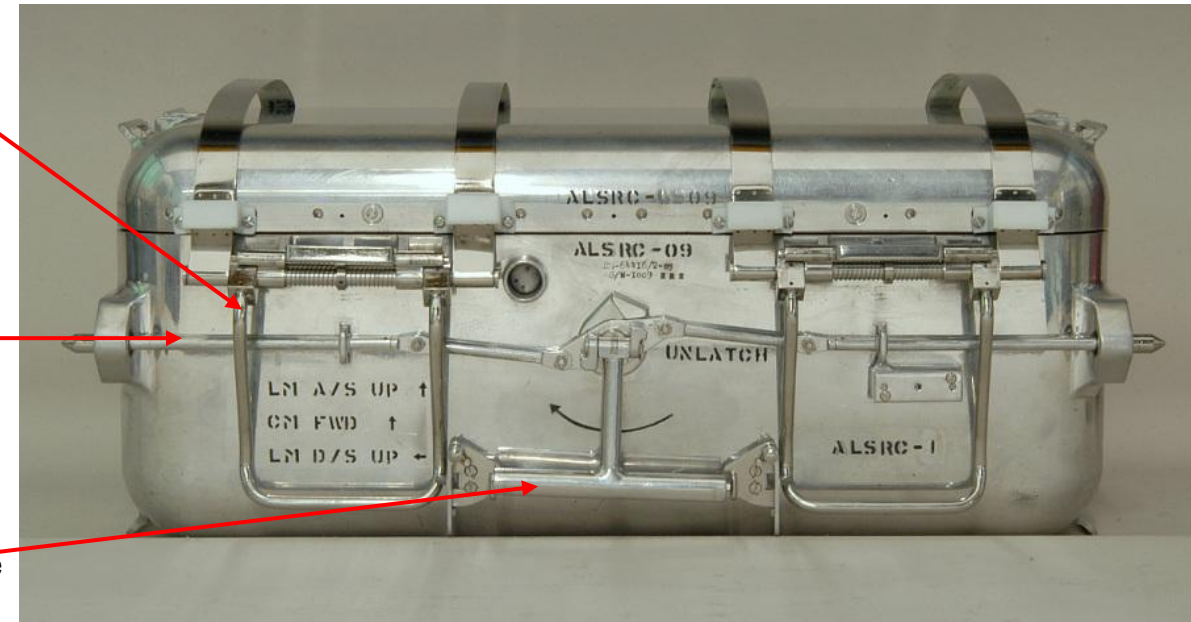
Lower lip



Latch rotated down to lock the box closed

Locking pins for keeping the box from shifting during launch from the moon and for landing on Earth

Acts as carrying handle

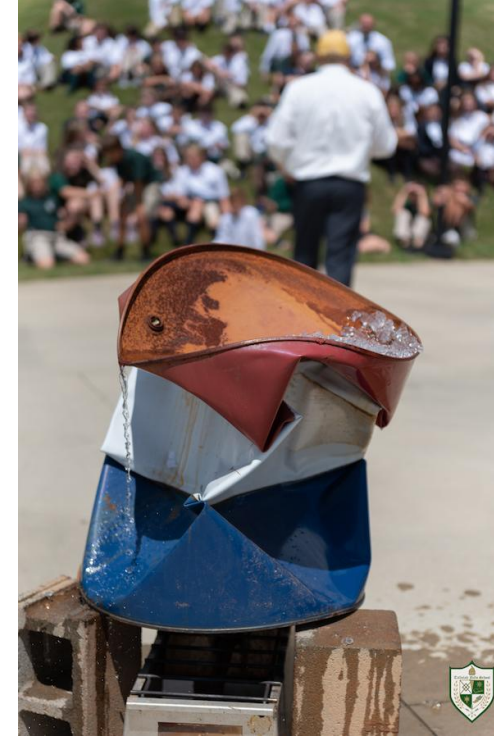


# Atmospheric pressure

When the samples are placed inside the containers, the rocks and the internal volume of the container will be at a vacuum. The containers need to be sturdy enough so they won't be crushed by the atmosphere when they get back to Earth.

<https://www.youtube.com/watch?v=j0TQxYemrgg>

<https://www.instagram.com/reel/DI9vMMHoxme/>



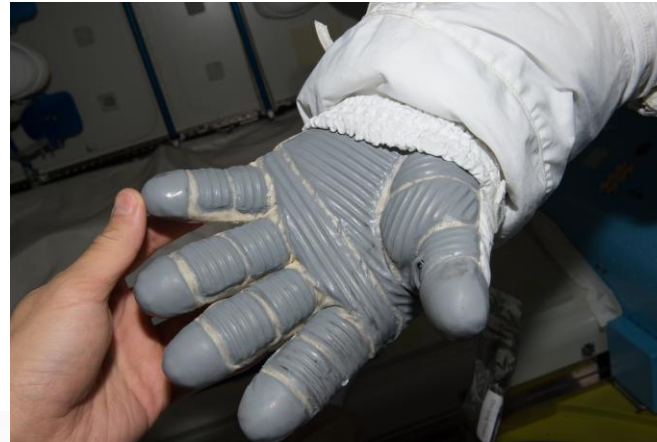
This plastic bottle was sealed at approximately 14,000 feet (4,300 m) altitude, and was crushed by the increase in atmospheric pressure, recorded at 9,000 feet (2,700 m) and 1,000 feet (300 m), as it was brought down towards sea level.

# Does it have to be a box? No

Zip lock bags that go inside  
Multiple layers?  
Must be able to do in heavy gloves



Vacuum provided by the moon.



<https://www.youtube.com/watch?v=SYHR3UgOhhs>

<https://www.youtube.com/watch?v=uStPMvVPXA4>

<https://www.facebook.com/PurdueME/videos/spacesuit-designer-amy-ross-puts-astronauts-in-good-hands/1853580991330484/>



# Control your load

- How are your sample containers going to be tied down or contained during launch?
- During launch and once in orbit around the moon, the rocks may be floating around. What options can you provide for keeping your sample holders from floating around and getting in the way of the crew?
  - Do you want them
    - in a bag?
    - Strapped down?
    - Special box on the ship?
- Have a plan for how your lunar samples will be controlled once on the ship for transport home.



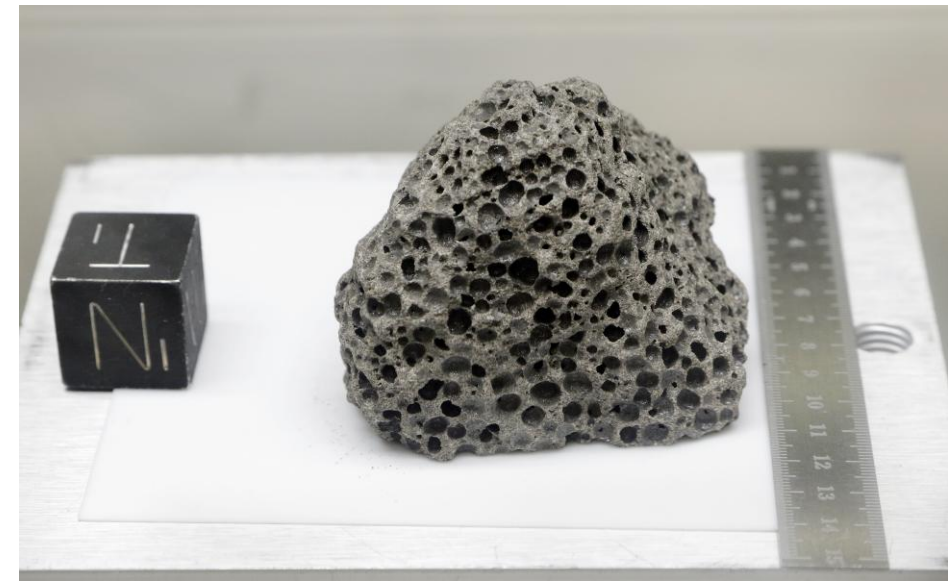
# How are samples going to be handled on Earth?

How were samples collected and returned to Earth?

- <https://www.youtube.com/watch?v=tDkbGXq-doE>
- <https://plus.nasa.gov/video/surprisingly-stem-moon-rock-processors-2/>
- [https://www.google.com/search?sca\\_esv=e126eb4d051b0442&rlz=1C1GCEA\\_enUS1172US1172&udm=39&fbs=AlljpHxU7SXXniUZfeShr2fp4giZ1Y6MJ25\\_tmWlTc7uy4Klei8e83z1Irt2kQldrQRStzvClfgW9ZNWPRAh5Aif9\\_QxEgufEFEokzU7Yl0ttcKTZnTQCF\\_aaiofaXwSl2gqgpUHToaLeSM5aHx0wtx0xyQLlvOFP1sQjwuL-nvQqCqdwQqKJmufOrg0p4xKpJQ9ja9ZGYOoBecI2O9bNFtAdW4odjSiu25RajgAm-w4PyybDmc2O0&q=how+are+lunar+samples+going+to+be+handled+once+on+Earth&sa=X&ved=2ahUKEwi7s5jrv86PaxLj2oFHUoVCHAQs6gLegQIEBAB&biw=1536&bih=791&dpr=2.5#fpstate=ive&ip=1&vld=cid:180cb251,vid:CwKL1N8IbiY,st:0](https://www.google.com/search?sca_esv=e126eb4d051b0442&rlz=1C1GCEA_enUS1172US1172&udm=39&fbs=AlljpHxU7SXXniUZfeShr2fp4giZ1Y6MJ25_tmWlTc7uy4Klei8e83z1Irt2kQldrQRStzvClfgW9ZNWPRAh5Aif9_QxEgufEFEokzU7Yl0ttcKTZnTQCF_aaiofaXwSl2gqgpUHToaLeSM5aHx0wtx0xyQLlvOFP1sQjwuL-nvQqCqdwQqKJmufOrg0p4xKpJQ9ja9ZGYOoBecI2O9bNFtAdW4odjSiu25RajgAm-w4PyybDmc2O0&q=how+are+lunar+samples+going+to+be+handled+once+on+Earth&sa=X&ved=2ahUKEwi7s5jrv86PaxLj2oFHUoVCHAQs6gLegQIEBAB&biw=1536&bih=791&dpr=2.5#fpstate=ive&ip=1&vld=cid:180cb251,vid:CwKL1N8IbiY,st:0)

Smarter Everyday

- [https://www.youtube.com/watch?v=QxZ\\_iPlDGtl](https://www.youtube.com/watch?v=QxZ_iPlDGtl)



# Requirements for Lunar Sample Box

1. Demonstrate the procedure of opening the box, placing two baseball sized rocks (and/or an equivalent volume of dirt) inside, and closing the box while wearing welding gauntlets. (try to get some clean ones)
2. Show the sealing mechanism for maintaining an internal vacuum.
3. Show your valuable internal features for keeping rock samples safe and pristine
4. Demonstrate how the box is carried once filled with samples
5. Explain/demonstrate how the box might be stored inside space craft. You must have verifiable evidence that the closed box has seals capable of preventing leakage.
6. Take pictures/video of the box submerged under water for 2 min. and pictures/video of the interior after being submerged.