

Team 515 Abstract

Reusable Shock Absorber for the Next Lunar Lander

Josh Blank
Design
Engineer

Matt Fowler
Systems
Engineer

Tristan Jenkins
Design
Engineer

Alex Noll
Mechanical
Engineer

Melanie Porter
Dynamics
Engineer

In the 2024 Artemis mission, NASA is sending a team, including their first woman, to the moon to create a long-term presence. An outpost called Gateway will orbit the moon, allowing travel from the outpost to the moon's surface. A human lander will repeatedly carry the astronauts between Gateway and the surface with little needed maintenance between trips.

Extreme space conditions make it challenging to design for moon landings. The moon's surface has a top layer of sharp rocks and dusty material. Motion can turn this into a cloud and cover sensors. Previously, the Apollo-class moon lander crushed a honeycomb cartridge to absorb the impact energy. This design was not reusable, needing a new cartridge for each landing. Because of the back-and-forth nature of our mission, this won't work. Our challenge is to create a reusable design that can withstand the debris and moon's low temperatures.

We have designed a reusable shock absorber that stores the impact energy in a spring, holds it, and later releases it. Our design uses a spiral ratchet and pawl (the lever that blocks movement) to lock the spring after absorbing the impact. It's like if a pogo stick locked rather than bounced. Each ring of the spiral acts as teeth for the end of the lever to hold on to, locking it into place. We chose spiral teeth to have a controlled release of the spring. A motor within the leg slowly rotates the spiral ratchet back to the starting length.

The design is reusable since it loads and then unloads a spring. We picked materials for our design that safely handle the extreme temperatures of the moon. The moving parts will have a cover to protect them from the harsh conditions. Our design will bring down cost, time, and materials to carry out further moon missions.