



Unlocking the Moon's Value with New, Innovative Solutions

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Introduction

The Moon offers a tremendous amount of value for humans right here on Earth. The first samples brought back from the Moon during the Apollo era changed the way we thought about the solar system, the history of Earth, and our place in the universe, and there's still so much science to uncover. From an environmental perspective, the Moon offers an abundance of resources, such as water, oxygen, and rare-Earth metals, that can be used to produce fuel, support manufacturing needs, and unlock new commercial applications. And from an economic standpoint, the global space market is expected to exceed \$1 trillion and drive millions of high-paying jobs.

The Moon is also the gateway to our solar system. It has a harsh environment that we must solve for before we can explore further into the solar system. So how do we unlock the value of the Moon and beyond? We must find solutions to mitigate hazardous lunar dust, survive the cold lunar night, navigate the lunar surface, and utilize lunar resources. Masten Space Systems is playing a key role in building new, innovative technologies to solve these pressing challenges and unlock the value in space for humans on Earth.

NITE™ System: Surviving the Lunar Night

Temperatures on the Moon can reach as low as -232°C (or -387°F) during the long lunar night, causing spacecraft systems, rovers, and payloads to fail over the 336 hours of darkness. Current solutions for surviving extreme lunar environments include lithium-ion batteries and alkaline fuel cells. Although these solutions are reliable and cost effective, they impose significant mass penalties, have relatively short lifespans, and require complex thermal or fluid systems.

Masten's Nighttime Integrated Thermal and Electricity (NITE™) system solves this challenge by delivering heat and power through the oxidation of metals using propellant margin from the lander's propulsion system or from an independent reservoir. It recycles reaction products to maximize thermal and electric energy return.

The NITE system is designed as a low-mass payload that can be attached to landers, rovers, and other lunar assets for both robotic and crewed missions. The system autonomously operates when temperatures fall below a specified threshold, enabling landers and payloads to extend mission operations for at least 12 months.

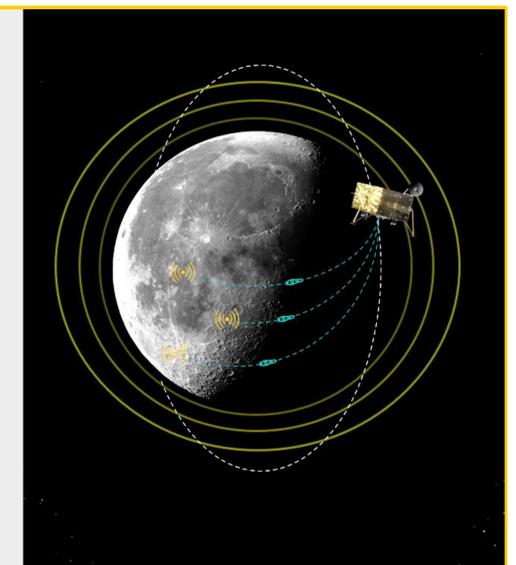


Lunar PNT Network: Navigating the Lunar Surface

Unlike Earth, the Moon isn't equipped with GPS so lunar spacecraft, assets, and future human explores are essentially operating in the dark. Masten is providing a solution to this challenge with a lunar surface-based network that enables navigation and location tracking for spacecraft, assets, and astronauts on the lunar surface or in lunar orbit.

The network consists of positioning, navigation, and timing (PNT) beacons that can be deployed by a spacecraft in lunar orbit or a rover on the lunar surface to create a dedicated sensor array on the Moon. The PNT beacons are secured in shock-proof enclosures that are equipped to survive harsh lunar conditions and remain embedded in the lunar surface for future missions.

As a shared autonomous network, the infrastructure will provide wireless connectivity to lunar spacecraft, objects, astronauts, and orbital assets for navigation, tracking, and positioning purposes. It functions like GPS without requiring a lunar satellite constellation.

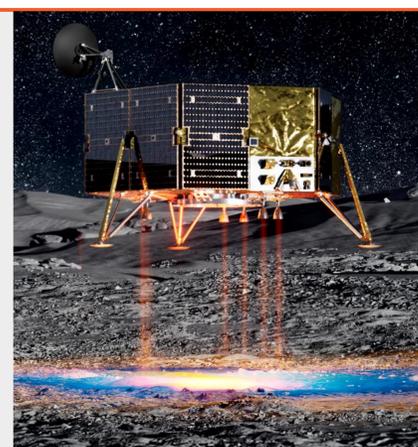


FAST Landing Pads: Mitigating Lunar Dust

Razor-sharp regolith is a major challenge for the future of space exploration. Kicked up by robotic and human spacecraft, this dust can damage landers, payloads, infrastructure, and harm astronauts. Large, deep craters created by the rocket plumes also pose a hazard for spacecraft landing gear stability.

Masten is solving this challenge with an in-flight Alumina Spray Technique (FAST) that creates instant landing pads by injecting ceramic particles into a rocket engine nozzle and creating a coating over the regolith prior to landing. The particles impact the surface and solidify to build up a hard landing pad with high thermal resistance.

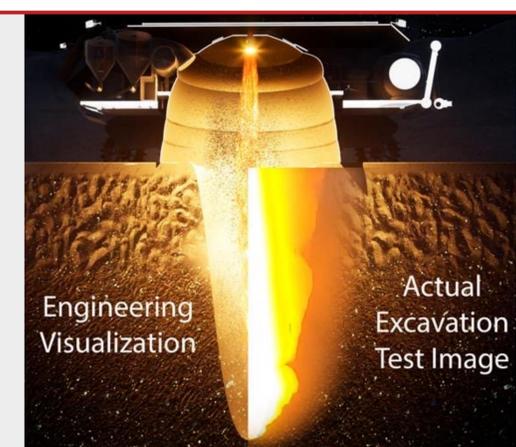
This approach reduces deep cratering and prevents regolith ejecta from impacting the surrounding environment. That means spacecraft can safely land anywhere on the Moon without the need for a precursor pad construction mission that can cost \$120 million or more.



Rocket Mining System: Extracting Lunar Ice

Usable as drinking water, rocket fuel, and other vital resources, lunar ice is critical to maintain a sustained presence on the Moon and allow future missions to Mars and beyond. Masten's Rocket Mining System enables rapid extraction of lunar ice by utilizing a series of rocket plumes under a pressurized dome to fluidize ice particles.

The small, low mass system, including the rocket engine, collapsible dome, beneficiation system, and storage containers, can be attached to a rover and delivered to the Moon on Masten's lunar landers. The Rocket Mining System is projected to mine up to 12 craters per day and produce 100 kg of ice per crater. That would allow us to recover more than 420,000 kg of lunar water per year with a system designed to be robust and affordable.



About Masten

Masten Space Systems is a space infrastructure company enabling sustainable access and utilization of the Moon, Mars, and beyond. Founded in 2004, Masten has been building and flying reusable rockets for nearly two decades with the most successful rocket-powered landings in the industry. The company is now applying its terrestrial flight experience to lunar missions that will accelerate space ecosystems and enable new commercial applications. Masten's end-to-end mission solutions include everything from tech development and rocket testing to off-Earth delivery and operations. Based in Mojave, California, Masten aims to unlock the value in space to benefit humans on Earth, starting with Masten Mission 1 to the lunar south pole. For more information, visit www.masten.aero or contact us at moon@masten.aero.