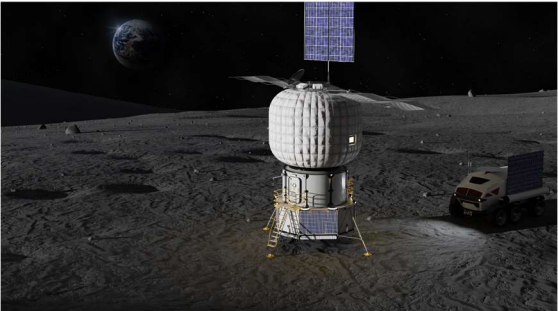


# Habitation Systems Development Office

The Habitation Systems Development Office (HP40) at NASA Marshall Space Flight Center supports systems engineering, integration, and project management for next generation space habitats. The office is responsible for formulation activities related to planetary surface habitation for the Moon and Mars as well as transit habitats for deep space exploration. Team members additionally support the Gateway and Commercial Low Earth Orbit Destinations (CLD) programs. HP40 also manages NextSTEP Appendix A: Habitation Systems and works with commercial partners on future habitat concept development and risk reduction activities.

The establishment of the Gateway and initial Artemis lunar missions will demonstrate the ability to safely land crew on the surface and return them to the lunar orbiting outpost. Missions later in the Artemis campaign will emplace a habitat supporting foundational exploration, gradually scaling to support a sustained presence at the lunar south pole. The initial lunar surface habitat represents a core capability to support human exploration initiatives. The Apollo missions ranged from 7-12 days, with landing sites in the moon's equatorial region. This initial surface habitat (SH) will support crew for 30 days with evolvability to 60 days. While the Apollo missions only landed and conducted operations during the period of lunar day, the surface habitat must also operate during multiple days of lunar darkness throughout the year, when temperatures can plummet to 120K (-153C) or below in some areas. Under current assumptions, the surface habitat will provide accommodations for 2 crew, with a surge capacity of 4 crew for short durations, such as during crew swap-outs between SH and a pressurized rover. SH has functional space for medical care, sleeping quarters, a galley and kitchen, science, extravehicular (EVA) preparation and repair, waste processing, communications, and life support systems.

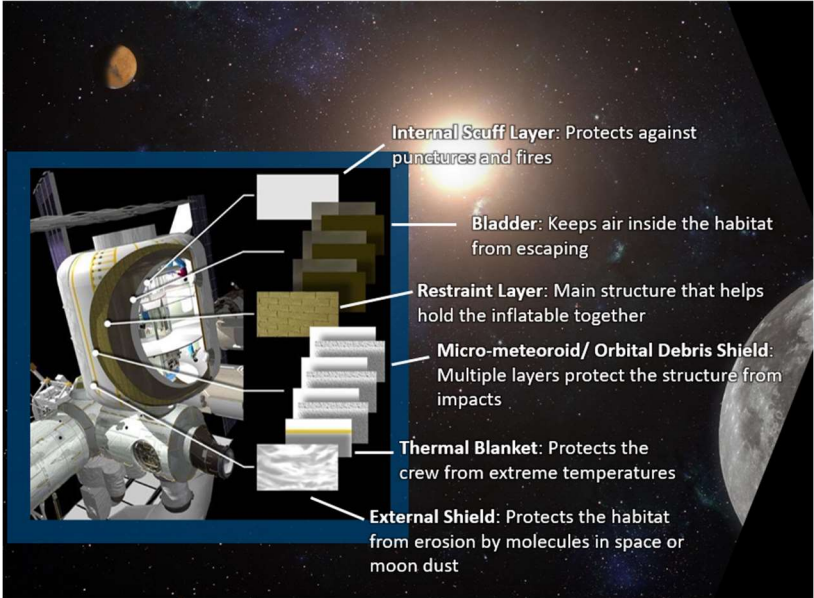


Lunar surface habitat concept pictured with pressurized rover. The lower portion of the habitat is a metal (two-chamber) airlock which permits ingress/egress to the habitat for crew and logistics transfer from other surface assets. The primary habitable volume is an inflatable softgoods structure.



Concept rendering of the Mars Transit Habitat.

For in space operations and eventual transport of humans to Mars, NASA will rely on a Mars Transit Habitat (TH), pictured above. Following deployment, the TH will complete a series of longer duration missions and shakedown testing while docked at Gateway, leveraging Gateway's habitation redundancy for safety measures. Proposed Gateway-TH missions will far exceed the longest duration low earth orbit human missions to date. They will be the first operational readiness tests of our long-duration deep space systems, and of the split crew (two crew on the surface, two crew in space) operations that are vital to the approach for the first human Mars mission. The TH will be designed to be capable of up to ~1,200-day Mars missions with the ability to carry all food and supplies needed to support a crew of four for this duration.



Many future habitation concepts incorporate inflatable softgoods technology for structural materials. Softgoods are a multi-material system which protect the habitat from micrometeoroid orbital debris (MMOD), contain the internal pressurized environment, provide structural support, and help the habitat to maintain a comfortable temperature. Relative to metallic structures historically used for habitation, inflatable softgoods may enable a larger habitable volume for the same launch mass.

## NextSTEP Habitat

NASA's NextSTEP Appendix A: Habitation Systems public/private partnership began in 2016 and has spurred the development of next generation space habitats for the Moon and Mars in the commercial sector. Current companies in the program include Boeing, Lockheed Martin, and Sierra Space.

## Lunar Gateway

Gateway is a lunar orbiting outpost where crew can live and work in cislunar space. Gateway's near rectilinear halo orbit (NRHO) offers access to all of the lunar surface. Gateway also serves as a waystation for vehicles in cislunar space, including the Orion capsule, Human Landing System, and the proposed Mars Transit Habitat. HP40 supports systems engineering and integration for Gateway.

## XHab

HP40 engages with universities through NASA's XHab program. Previous projects have focused on manufacturing to support outfitting and human factors testing of outfitting operations for inflatable softgoods, such as deployment of flooring and installation of racks. The 2022-2023 project with University of Maryland considered concepts for logistics transfer within a habitat and on the lunar surface.