Dream bigger. Go further: Airbus builds the European Service Module for NASA's Artemis mission

February 2026 - Almost 50 years after the last human, NASA astronaut Gene Cernan, left the lunar surface to return to Earth, the US space agency NASA set out once again to visit Earth's satellite; not just for a few days only, but to establish the foundations for a permanent human outpost in the long term. Under its Artemis programme NASA is returning to the Moon with a landing on its surface envisaged in 2027/2028. Europe and Airbus are playing a major role in this ambitious Artemis undertaking.

Following the successful test flight of Artemis I, the upcoming Artemis II mission is the first crewed flight of the Orion spacecraft, taking astronauts Reid Wiseman, Victor Glover, Christina Koch (all NASA) and Jeremy Hansen (Canadian Space Agency) on a 10 day journey to and around the Moon. When NASA's new Orion spacecraft sets course for the Moon, it will rely on Airbus technology for essential functions that the astronauts need to stay alive – from the supply of air and water to propulsion, power and thermal control, all provided by the Bremen-made Orion European Service Module (ESM).

The 2022 Artemis I Mission was an uncrewed test flight. Launched in November that year, the mission saw the Orion spacecraft venture toward the Moon and orbit around it before returning to Earth. It was a challenging time of 25 days for the Orion spacecraft, the ESM and the entire team. The spacecraft travelled 2.25 million kilometres in total, and nearly 70,000 km beyond the Moon, was exposed to temperatures of +- 200 °C and flew at a maximum speed of 40,000 km/h. All systems were tested and functioned flawlessly, most performing even better than envisaged. For example, the ESM-1 generated 20% more power than expected while consuming 25% less power than predicted.

Off to the Moon with Orion and its European Service Module

The design of the Orion spacecraft enables astronauts to be transported further into space than ever before, providing life support for the crew during the flight and enabling a safe return to Earth.

The spacecraft consists of two main parts: the Crew Module, which is the habitat for up to four astronauts and their cargo, and the Service Module, which provides propulsion, power, water, oxygen and nitrogen as well as keeping the spacecraft at the right temperature and on course. The Service Module is installed underneath the crew module, attached via the Crew Module Adapter, which connects the systems between the two modules. Together, they form the Orion spacecraft.

For the first time ever, NASA has entrusted a non-US company to build a mission-critical element for an American human spaceflight mission: Under a European Space Agency (ESA) contract, Airbus in Bremen, Germany, is responsible for building the European Service Module, which both propels and manoeuvres the Orion spacecraft and provides the spacecraft's crew with essential life support elements such as water and oxygen, as well as regulating thermal control.

The European Service Module: an integral part of NASA's Artemis mission

The Orion ESM is cylindrical in shape and approximately four metres in diameter and height. At launch, it weighs just over 13 tonnes, making up roughly 3/5 of the Orion spacecraft's total mass. Its 8.6 tons of fuel power the main engine, eight auxiliary thrusters and 24 smaller thrusters used for attitude control.

In addition to its function as the main propulsion system for the Orion spacecraft, the ESM will be used for orbital manoeuvring and position control. It also provides the crew with central elements of life support and regulates thermal control while docked to the Crew Module. Furthermore, the ESM can be used to carry additional unpressurised payload.

The ESM relies on a distinctive four-wing solar array, each wing consisting of three separate panels that will unfold to their seven-metre length after launch, hence giving the spacecraft a 'wingspan' of 19 metres across. 15,000 solar cells generate enough energy to power the equivalent of two households. Each of the four arrays turns on two axes in order to be able to align with the Sun for maximum power generation.

The ESM's exterior is covered with Kevlar in order to prevent damage from micrometeorites and space debris. In addition, key redundant systems such as the avionics are positioned on opposite sides of the module.

More than 20,000 parts and components make up each ESM, from electrical equipment to engines, solar panels, fuel tanks and life support supplies, including approximately 12 kilometres of cables.

At the end of the mission, the ESM will burn up in the Earth's atmosphere, while the Crew Module will splash down in the Pacific Ocean.

Further Service Modules for upcoming Artemis missions

Airbus has been contracted by ESA, which is investing about €2 billion in the Orion programme, to build a total of six European Service Modules (ESM-1 to 6).

The first module, ESM-1 – christened 'Bremen' – was launched on the Artemis I Mission. The ESM-1 was delivered to NASA in November 2018, and mated with the Orion Crew Module. After the fully integrated spacecraft underwent thermal-vacuum testing at NASA's Plum Brook Station facility in Ohio, Europe officially handed the ESM-1 over to the US in December 2020.

The second ESM was flown from Bremen to Kennedy Space Center on a cargo aircraft in October 2021, integrated with the Orion Crew Module and tested extensively before integration with the SLS launcher for the upcoming Artemis II mission.

ESM-3 will power the Artemis III mission, set to see the first woman and first person of colour setting foot on the Moon. It is currently undergoing final integration at Kennedy Space Center (KSC).

The ESM-4 was delivered to KSC in late 2025, while ESM-5 and ESM-6 are currently in production in Airbus' Bremen cleanrooms with shipments slated for 2027 and 2028, thus ensuring a steady cadence for NASA's long-term lunar presence and the future Lunar Gateway station.

Spacelab, Columbus, ATV: substantial heritage in human spaceflight

During the development and construction of the ESM, Airbus not only relies on partners from 10 countries across Europe (Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland) and the USA, but is also able to draw on its heritage as a prime contractor for a number of previous human spaceflight programmes.

The Spacelab, a small, reusable research facility designed to fit in the Space Shuttle's cargo bay, the International Space Station's Columbus Module, and most importantly the five Automated Transfer Vehicle (ATV) missions, which provided the International Space Station (ISS) with supply deliveries from 2008 to 2015, provided Airbus with the essential experience and capabilities required for the Orion ESM.

Recognising these 40+ years of experience, this is the first time NASA will use a European-built system as a mission-critical element in a US human spaceflight mission.

Back to the Moon – to stay, and venture onward

While the Moon is conveniently close to Earth, it also provides the resources needed for reaching destinations beyond – making it an ideal point of origin to prepare for the next 'giant leap': human exploration of Mars.

NASA's Artemis programme envisions a space station being placed in an elliptical lunar orbit which could then be used as a staging base for lunar landings. During the Artemis IV and V missions, it is planned to dock the Orion spacecraft with the International Lunar Gateway.

The first Artemis missions will pave the way for humans to continuously live on the Moon. On their missions, the Artemis astronauts will investigate its surface and learn how to live and work there.

The creation of a continuous human presence on the Moon will be crucial to building up operational experience in reliably supporting life away from Earth. The technology boost from this back on Earth could be phenomenal - as happened from the Apollo missions which ultimately led to the birth of Silicon Valley and of the computers and smartphones we use today. It will build the confidence needed for conducting long-term missions, before multi-year human missions to Mars can be envisaged in the future.

Quote

Marc Steckling, Head of Earth Observation, Science and Space Exploration at Airbus, said: “When I look up at the night sky and see the Moon, I often ponder just how fascinating it is that humans will soon be able to land on its surface and conduct research. With Spacelab, the ISS Columbus Laboratory and the Automated Transfer Vehicle, Airbus has accumulated unparalleled, globally recognised expertise in human space flight technology. What’s more, we are working with key space partners as part of a worldwide network. Thanks to all of this, we are qualified to develop and build the European Service Module for the Orion spacecraft, and NASA has - for the first time ever - agreed to allow a non-US company to build a mission-critical element for one of their human spaceflight missions.”

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