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NASA's SLS (Space Launch System) Rocket Ready for Artemis II Lunar Mission

Figure 1. Artemis II launch at 6:35 p.m. EDT, April 1, 2026

ABSTRACT

In early 2026, NASA launched the Artemis II mission, an approximately 10-day long lunar mission that flew three NASA astronauts and one CSA (Canadian Space Agency) astronaut on a free-return trajectory around the Moon, following a one-day checkout of their Orion spacecraft in Earth orbit. The mission was the first to launch astronauts aboard NASA's Orion spacecraft and on top of the agency's SLS (Space Launch System) rocket. The mission also deployed four 12U CubeSats as secondary payloads from the Orion stage adapter, following Orion separation and departure. The payloads, developed by four of NASA's international partners, hosted a variety of science and technology investigations. In addition to preparations for and the launch of the Artemis II mission, significant progress is being made on the SLS for the Artemis III mission, which is will be an Earth orbit rendezvous mission with the human landing systems in mid-2027. Major components of the core stage and solid rocket boosters are already at NASA Kennedy undergoing build-up for the mission. Data from the Artemis II launch and mission, as well as progress to subsequent missions, as available, are presented.

INTRODUCTION

Humans are returning to the Moon, and the United States is leading the charge for the free world, taking a coalition of nations to establish a permanent lunar base where key technologies and procedures needed for the exploration of Mars will be developed and tested. A key piece to the architecture, called the Artemis campaign, is NASA's SLS (Space Launch System) heavy-lift rocket.

The second flight of SLS launched the Artemis II mission on April 1, 2026. The mission was the first to launch astronauts aboard the rocket and in the Orion spacecraft. While data are still being analyzed, early data indicate the SLS performed as expected, including as well and better on some parameters than the incredibly successful Artemis I flight of SLS in November 2022.

During Artemis II, the Orion spacecraft reached a maximum distance from Earth of 252,756 statute miles, surpassing the previous record set during the Apollo 13 mission in 1970 by 4,111 statute miles. The mission had a closest approach to the Moon of 4,067 statute miles.

The mission concluded on April 10 at 8:07 p.m. EDT, with a total mission elapsed time of 9 days, 1 hour, 32 minutes. The mission covered 694,481 statute miles.

The initial SLS architecture uses a core stage, powered by four RS-25 liquid hydrogen/liquid oxygen (LH2/LOX) engines, and two five-segment solid rocket boosters for the ascent phase. The upper stage is the interim cryogenic propulsion stage (ICPS), which is mated to the core stage below using the launch vehicle stage adapter (LVSA) and to the Orion spacecraft above using the Orion stage adapter (OSA). In addition to launching Orion and its team of four astronauts, the Artemis II SLS also launched four 12U CubeSats, developed by international partners. In this configuration, SLS is capable of launching 59,000 pounds (27 metric tons) to the Moon in a single launch.

Beginning on Artemis IV, SLS will use the United Launch Alliance (ULA) Centaur V upper stage, powered by two RL10C engines. The stage, which is a continued evolution of the Delta and Atlas upper stages, has successfully helped launch four missions on ULA's Vulcan rocket. The performance metrics of this configuration are still being analyzed.

ARTEMIS II LAUNCH AND FLIGHT

On April 1, 2026, at 6:35 p.m. Eastern Daylight Time, the four RS-25 liquid engines and twin solid rocket boosters lifted the Artemis II SLS rocket, Orion spacecraft, and four astronauts off the pad and began accelerating to space. Two minutes and 7 seconds into flight, the twin solid rocket boosters separated, and the vehicle continued to orbit. RS-25 main engine cutoff (MECO) occurred at T+8:01. Core stage separation occurred seconds later.

Two burns by the ICPS were then completed. The first was a perigee raise maneuver, which lifted the perigee insertion perigee out of Earth's atmosphere and inserted ICPS and Orion into a stable orbit. The trajectory was used to ensure core stage atmospheric disposal over the Pacific Ocean. The next burn was the apogee raise burn, which placed the Orion spacecraft in an orbit with a high Earth orbit apogee.

Preliminary ascent and orbital insertion data are:

- Insertion velocity: 27,227.75 feet per second (ft/s) actual; 27,224.10 ft/s, predicted; 99.99% accuracy
- Initial orbit apogee: 1200.21 nautical miles, actual; 1200 nautical miles, predicted; 99.98% accuracy
- Initial orbit perigee: 15.07 nautical miles, actual; 15 nautical miles, predicted; 99.54% accuracy

Subsequent to the apogee raise burn, the Orion spacecraft separated from the ICPS. The spent stage was then used as the target for the proximity operations demonstration but its atmospheric disposal over the Pacific Ocean.

After the conclusion of the proximity operations demonstration, the Orion spacecraft performed a departure burn, followed by a disposal burn by the ICPS. After the disposal burn was completed, four CubeSats were deployed from the OSA, which is mated to the ICPS. The spacecraft were developed through partnerships with Argentina, Germany, Saudi Arabia, and South Korea. Preliminary data indicate they were deployed within the environmental conditions expected. We defer to the payload developers to provide information on their spacecraft performance.

Figure 2. The Earth is seen setting behind the Moon as the Artemis II astronauts fly around the farside of the Moon on Flight Day 6.

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While data from the flight are still being analyzed, preliminary data indicate that SLS performed as expected, hitting orbital insertion targets with 99.5-99.9 percent accuracy. The ICPS also delivered the Orion spacecraft to the proper target with a high degree of precision and accuracy. The individual systems behaved as expected, and overall flight performance was nominal.

Figure 3. The Artemis II astronauts seen with their Orion spacecraft on the well deck of the recovery vessel, the U.S. Navy's USS John P. Murtha.

WET DRESS REHEARAL

Prior to the April 1 launch, a key final major milestone before launch was the wet dress rehearsal (WDR).

After rolling out to Launch Complex 39B on January 17, completing connections between the pad systems and the mobile launcher, and a series of planned engineering tests on the Ground, SLS, and Orion systems, WDR began February 1. The 48-hour test was delayed two days from its initial start due to an abnormal cold weather system that set up over much of Florida. The predicted temperatures, winds, and associated windchills would have produced an unsafe operational environment for the pad teams, including the closeout crew.

WDR-1 officially commenced at 8:13 p.m. EST on January 31. The time was chosen to mimic the timing of the opening of the first launch window, providing higher probability of similar conditions across the vehicle during the test and following launch attempt.

Figure 4. The Artemis II SLS with a full Moon prior to the first WDR.

During the test, teams successfully filled all tanks in both the core stage and ICPS, and the Closeout Crew successfully rehearsed closure of the command module and launch abort system hatches. However, multiple technical issues occurred across the integrated launch vehicle and ground systems infrastructure presented themselves. Liquid hydrogen leaks at tail service mast umbilical – the interface between the mobile launcher and SLS – occurred. In addition to the LH2 leak, a valve associated with the crew module hatch pressurization had to be replaced, and dropouts of audio communication channels had to be troubleshooted.

Despite the challenges, the team was able to get into the terminal countdown portion of the test, which encompasses the final 10 minutes of the launch countdown. At T-5 minutes, 15 seconds, when the core stage liquid hydrogen tank was pressurized for flight, the leak rate of the LH2 spiked beyond accessible limits. A hold was called, and the test was terminated.

Post-test reviews repairs replaced seals at the SLS-tail service mast umbilical interface. Discussions with the vendor led to process improvements, and the leaks seen on Artemis I and the first Artemis II WDR were not seen again. Other adjustments across the SLS rocket, Orion spacecraft, and ground systems hardware and procedures were made.

Following WDR-1, a tanking test was conducted to test the new seals. As the LH2 loading progressed into fast fill from slow fill, a pressure difference was detected across one of the filters in the ground system lines. The filter was believed to be partially blocked. To prevent any foreign object debris (FOD) from reaching the launch vehicle, a hold was initiated and flow of LH2 to the vehicle was stopped.

Multiple mitigation techniques were exercised, including letting the filter warm back up. Scanning of the filter using spectroscopy was performed in an attempt characterize the blockage. The spectrometer was calibrated with helium and nitrogen backgrounds, and its signal became nosier when looking at the LH2-

rich sample and therefore was not fully able to diagnose the problem. In order to properly protect the vehicle, it was decided not to attempt to load the vehicle any further. However, some of the test objectives were accomplished with the propellant that had not boiled off during draining operations, including verification of the replacement seals.

Following the test, teams replaced a filter in ground support equipment that was suspected to be the cause of the reduced LH2 flow during the partial tanking test. Proper environmental conditions were then reestablished, and WDR-2 was conducted.

The second wet dress rehearsal commenced on February 19 and concluded on February 21. It was an incredibly successful test. WDR successfully tested SLS, Orion, and ground system procedures. One of the key portions was holding the countdown after entering terminal count and then proceeding the designated cutoff point at T-33 seconds. Once at the cutoff point, the count was recycled to T-10 minutes to prove the system's capabilities to recycle. Terminal count resumed, and a final nominal cutoff was given at T-29 seconds. The test was complete.

While re-filling the onboard helium tanks on the ICPS after WDR-2, flow of the helium to the vehicle became inhibited. Troubleshooting commenced at the pad, but due to limited access in that area at Launch Complex 39B, a rollback to the Vehicle Assembly Building was required to fix the issue, pushing the Artemis II launch out of the March launch window.

Figure 5. The Artemis II launch vehicle returned to the VAB for repairs following the first WDR.

Once inside High Bay 3 of the VAB, the umbilical was disconnected and the area investigated. Analysis, supported by ground testing, showed that during the flow of helium to the upper stage, a seal at the interface between the ground umbilical and SLS became dislodged and blocked the flow.

Instead of replacing the seal, it was decided to redesign a portion of the interface and remove the seal entirely. In its place, another seal was reinforced, and evaluation on test stands and on the flight hardware proved it to be a viable solution.

With the launch vehicle in the VAB, teams had to complete other work required for launch and took the opportunity to work on other areas of the vehicle. Work in the VAB included:

- Requalification of the flight termination system, as required by the U.S. Space Force's Eastern Range
- Replacement of batteries on the flight termination system and the FTS
- Replacement of the LOX TSMU seal
- Charging of the SHMS CubeSat (formerly called Space Weather CubeSat-1) payload

Upon completion of the work, the vehicle was rolled out to Launch Complex 39B during the overnight and morning hours of March 20.

Once pad connections were completed, the launch campaign began on March 30 with a successful liftoff at 6:35 p.m. EDT April 1.

ARTEMIS III

Mission Architecture

Artemis maintains a flexible architecture with the primary objective being the establishment of a permanent lunar base. The flexibility enables the agency to adjust individual missions to best continue the progress of the architecture while driving down risks. A prime example of that is the Artemis III mission.

Originally targeted to be a crewed lunar landing mission, it was modified in early 2026 to become an Earth-orbit mission that will have astronauts onboard an Orion spacecraft, launched by an SLS, rendezvous and dock with at least one of NASA's Human Landing System (HLS) vehicles – SpaceX's HLS variant of Starship and Blue Origin's Blue Moon Mark 2. This critical mission will be the first meeting of the spacecraft in space and will include rendezvous, proximity operations, and intervehicle communications, and potentially docking – all of which will be critical to crewed lunar landings.

In addition to the vehicle maneuvers, the mission will also see the astronauts test the new Axiom-built spacesuits in microgravity. Critical procedures like donning and doffing the suits in space will provide critical data and experience to their operations prior to the first crewed lunar landing since 1972.

Similar in nature to the Apollo 9 mission in 1969, the mission is targeted to launch in 2027. More details about the Artemis III mission will be released in the coming weeks and months.

SLS Hardware Progress

The hardware for the Artemis III SLS is largely complete and is being aggregated at NASA Kennedy for final outfitting, stacking, and integration for launch.

In late April, the core stage top four-fifths – the liquid hydrogen, intertank, liquid oxygen tank, and forward skirt – was shipped from NASA's Michoud Assembly Facility in New Orleans to NASA Kennedy. The stage's engine section was transported to NASA Kennedy in December 2022 with the section's boat tail arriving in September 2024. Using High Bay 2 in the VAB, the engine section was integrated with the rest of the stage. The RS-25 engines will be shipped to NASA Kennedy this summer. They will then be installed on the stage later this year.

Figure 6. The Artemis III core stage's top fourth-fifths rolled out of NASA's Michoud Assembly Facility in New Orleans April 20.

The segments of the solid rocket boosters are also en-route to NASA Kennedy. The aft segments arrived at the facility in April where they are undergoing outfitting in the center's Booster Fabrication Facility. The motor segments containing the propellant will be shipped via train later this summer. The launch vehicle stage adapter and Orion stage adapter will be shipped from their manufacturing and storage facilities at NASA Marshall later this year.

Stacking is expected to begin in mid-late 2026.

ARTEMIS IV AND BEYOND

The Artemis IV mission is targeted launch in early 2028 and will be the first crewed landing on the lunar surface since Apollo 17 in 1972. The hardware for the mission is being prepared right now. The elements of the core stage are mostly completed with integration to follow. The solid rocket booster motor segments are cast, and the RS-25 engines are prepared and in storage.

Artemis V will be a crewed landing on the Moon. Targeted for late 2028, much of the hardware is already in development. Pieces of the core stage are being welded. This mission will be the first to use new production RS-25 engines, and the first two have successfully completed their acceptance hot fires. The remaining two engines will be tested later this year and early next. The motor segments for the solid rocket boosters will begin casting later this year.

CONCLUSION

The United States is leading the way back to the Moon. Building on the success of the Artemis II crewed lunar flyby mission, NASA along with industry, academic, and international partners are preparing to return astronauts to the lunar surface in 2028 and begin the build-up of a permanent lunar base. These activities will test technologies needed for the human exploration of Mars, will help build a sustainable economy on the lunar surface, and will enable the peaceful exploration of space while ensuring the United States remains the leader on the space frontier.