



Space Launch System

America's Rocket for Deep Space Exploration

NASA's Space Launch System, or SLS, is a super-heavy-lift launch vehicle that provides the foundation for human exploration beyond Earth's orbit. With its unprecedented power and capabilities, SLS is the only rocket that can send Orion, astronauts, and cargo to the Moon on a single mission.

Offering more payload mass, volume capability, and energy, SLS is designed to be flexible and evolvable and will open new possibilities for payloads, including robotic scientific missions to places like the Moon, Mars, Saturn, and Jupiter.

The SLS team is producing NASA's first deep space rocket built for human space travel since the Saturn V. Engineers are making progress toward delivering the first SLS rocket to NASA's Kennedy Space Center in Florida for its first launch on the Artemis I lunar mission.

The Power to Explore Beyond Earth's Orbit

To fulfill America's future needs for deep space missions, SLS will evolve into increasingly more powerful configurations. SLS is designed for deep space missions and will send Orion or other cargo to the Moon, which is nearly 1,000 times farther than where the space station resides in low-Earth orbit. The rocket will provide the power to help Orion reach a speed of 24,500 miles per hour; the speed needed to send it to the Moon.

Every SLS configuration uses the core stage with four RS-25 engines. The first SLS vehicle, called Block 1, can send more than 27 metric tons (t) or 59,500 pounds (lbs.) to orbits beyond the Moon. It will be powered by twin five-segment solid rocket boosters and four RS-25 liquid propellant engines. After reaching space, the Interim Cryogenic Propulsion Stage (ICPS) sends Orion on to the Moon. The first three Artemis missions will use a Block 1 rocket with an ICPS.



Artemis I on Mobile Launcher (artist concept)

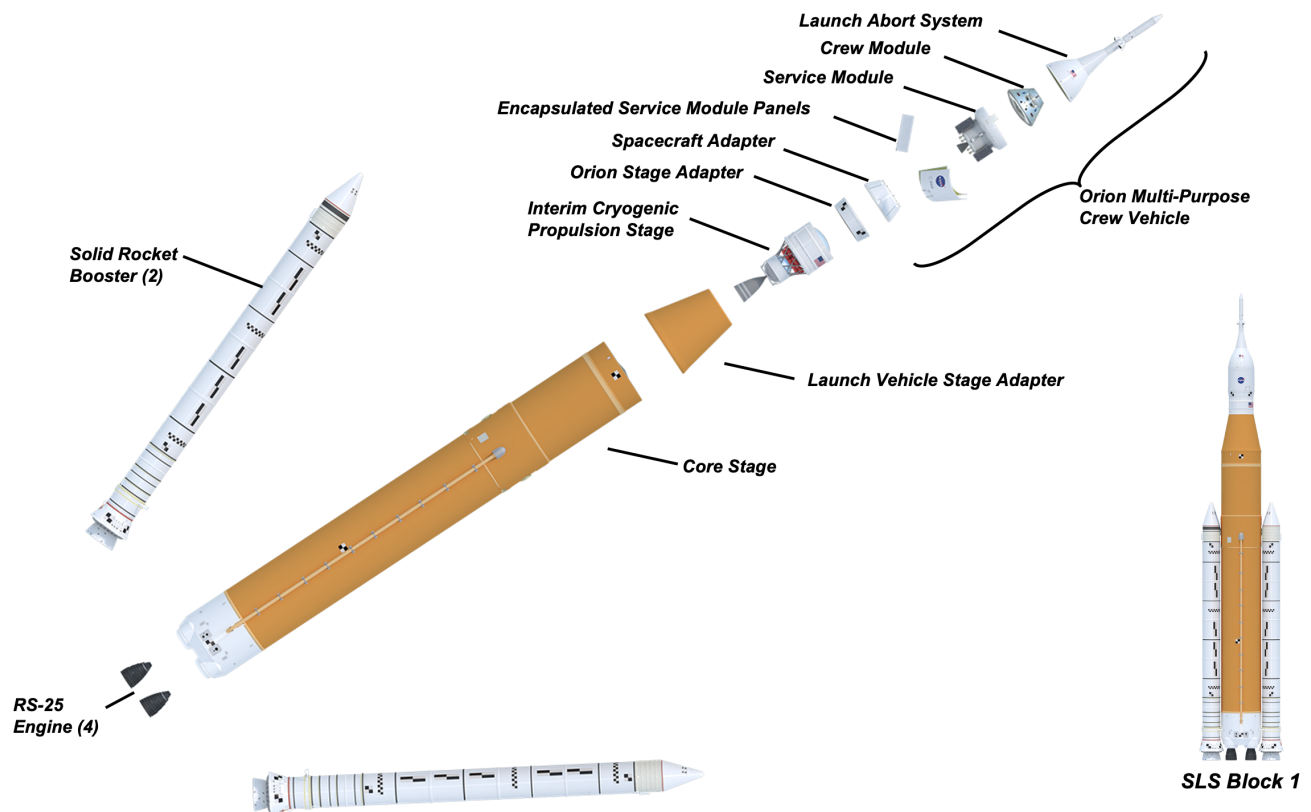
Block 1B crew vehicle, will use a new, more powerful Exploration Upper Stage (EUS) to enable more ambitious missions. The Block 1B vehicle can, in a single launch, carry the Orion crew vehicle along with large cargos for exploration systems needed to support a sustained presence on the Moon.

The Block 1B crew vehicle can send 38 t (83,700 lbs.) to deep space including Orion and its crew. Launching with cargo only, SLS has a large volume payload fairing to send larger exploration systems to the Moon and Mars or for science spacecraft on solar system exploration missions.

The next SLS configuration, Block 2, will provide 9.5 million lbs. of thrust and will be the workhorse vehicle for sending cargo to the Moon, Mars, and other deep space destinations. SLS Block 2 will be designed to lift more than 46 t (101,400 lbs.) to deep space. An evolvable design provides the nation with a rocket able to pioneer new human spaceflight missions.

NASAfacts

Block 1 - Initial SLS Configuration



Space Launch System Missions

Artemis I, the first integrated flight of SLS and Orion, uses the Block 1 configuration, which stands 322 feet taller than the Statue of Liberty, and weighs 5.75 million lbs. SLS will produce 8.8 million lbs. of maximum thrust, 15 percent more thrust than the Saturn V rocket.

For Artemis I, Block 1 will launch an uncrewed Orion spacecraft to an orbit 40,000 miles beyond the Moon, or 280,000 miles from Earth. This mission will demonstrate the integrated system performance of SLS, Orion, and Exploration Ground Systems prior to a crewed flight.

The Artemis II mission will send astronauts on a flight to orbit the Moon. These missions pave the way for landing astronauts on the Moon in 2024, during the Artemis III mission.

Building the Rocket

NASA is building the rockets needed for several missions. To reduce cost and development time, NASA is using proven hardware from the space shuttle and other exploration programs while making use of cutting-edge tooling and manufacturing technology.

Some parts of the rocket are new and other parts have been upgraded with modern features that meet the needs of deep space missions, which require higher launch vehicle performance levels.

Core Stage

The Boeing Company, in Huntsville, Alabama, builds the SLS core stages, including the avionics that controls the vehicle during flight. Towering more than 200 feet with a diameter of 27.6 feet, the core stage stores 730,000 gallons of super-cooled liquid hydrogen and liquid oxygen that will fuel the RS-25 engines.

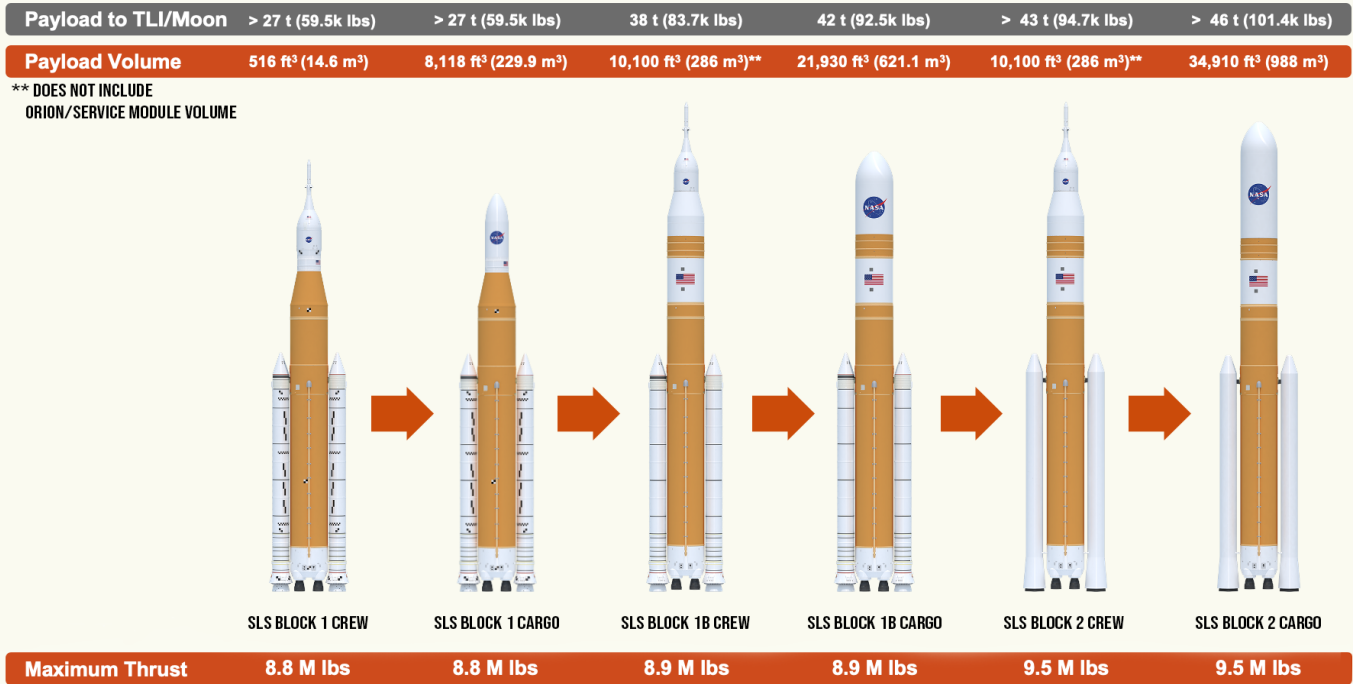
Core stages are built at NASA's Michoud Assembly Facility in New Orleans using state-of-the-art manufacturing equipment, including a friction stir welding tool that is the largest of its kind in the world.

The core stage for Artemis I is complete, and Boeing has started building structures for Artemis II and III. The SLS avionics computer software is being developed at NASA's Marshall Space Flight Center in Huntsville.



Artemis I core stage

SLS Evolution



NASA has designed the Space Launch System as the foundation for a generation of human exploration missions to deep space, including missions to the Moon and Mars. SLS will leave low-Earth orbit and send the Orion spacecraft, its astronaut crew, and cargo to deep space. To do this, SLS has to have enough power to perform a maneuver known as trans-lunar injection, or TLI. This maneuver accelerates the spacecraft from its orbit around Earth onto a trajectory toward the Moon. The ability to send more mass to the Moon on a single mission makes exploration simpler and safer.

RS-25 Engines

Propulsion for the SLS core stage will be provided by four RS-25 engines. Aerojet Rocketdyne of Sacramento, California, is upgrading an inventory of 16 RS-25 shuttle engines to SLS performance requirements, including a new engine controller, nozzle insulation, and required operation at 512,000 lbs. of thrust. During the flight, the four engines provide around 2 million lbs. of thrust.

The engines for Artemis I are built, tested, and attached to the core stage. The stage is undergoing testing at NASA's Stennis Space Center near Bay St. Louis, Mississippi. Next, the Pegasus barge will take the core stage to NASA's Kennedy Space Center in Florida where it will be prepared for launch. Aerojet Rocketdyne has finished testing new controllers and is assembling engines for the next four missions. They have restarted production of new engines and are doing development testing of new, advanced components to make the engines more affordable for future missions.



Four RS-25 engines attached to the core stage for Artemis I

Boosters

Two shuttle-derived solid rocket boosters will power the initial flights of the SLS. To provide the additional power needed for the rocket, the prime contractor for the boosters, Northrop Grumman, of Redondo Beach, California, has modified the original shuttle's configuration of four propellant segments to a five-segment version. The design includes new avionics, propellant design, and case insulation, and eliminates the recovery parachutes.

Northrop Grumman has delivered the 10 booster segments for Artemis I to Kennedy Space Center, has cast all booster segments for Artemis II at their Utah facility, and has started casting booster segments for Artemis III. Trains transport booster segments from Utah to Kennedy Space Center where they will be stacked with other space shuttle booster components. The boosters' avionics systems are being tested at Kennedy and Marshall.



Artemis I booster segments arrive at KSC via rail transportation

Spacecraft and Payload Adapter, Fairings, and Interim Cryogenic Propulsion Stage

The Orion stage adapter will connect Orion to the ICPS on the SLS Block 1 vehicle and is the place where small satellites will ride to space. The Orion stage adapter has been delivered to Kennedy for the first launch. Teledyne Brown Engineering of Huntsville has built the launch vehicle stage adapter that will connect SLS's core stage to the upper part of the rocket.



Artemis I launch vehicle stage adapter

The initial capability to propel Orion out of Earth's orbit for Block 1 will come from the ICPS, based on the Delta Cryogenic Second Stage used successfully on United Launch Alliance's Delta IV family of rockets.

It uses one RL10 engine made by Aerojet Rocketdyne. The engine is powered by liquid hydrogen and liquid oxygen, and generates 24,750 lbs. of thrust. This stage has been delivered to Kennedy and is ready for integration before the Artemis I launch.



Artemis I ICPS delivered to Kennedy Space Center

National Aeronautics and Space Administration

George C. Marshall Space Flight Center
Huntsville, AL 35812
www.nasa.gov/marshall

www.nasa.gov

FS-2020-09-38-MSFC

Exploration Upper Stage

The Exploration Upper Stage (EUS) is powered by four RL10 engines that produce almost four times more thrust than the one RL10 engine that powers the ICPS. This 97,000 lbs. of thrust will allow more than 38 t (83,700 lbs.) for Block 1B crew and more than 42 t (92,500 lbs.) for Block 1B cargo to be sent to the Moon.

With the EUS, NASA can use either a Block 1B crew configuration to send Orion, astronauts, and payloads to deep space or use a Block 1B cargo configuration to send large cargoes to the Moon, Mars, or more distant destinations.

Boeing is under contract to build the EUS at the Michoud Assembly Facility and has completed the preliminary design review.

Aerojet Rocketdyne is under contract to produce the RL10 engines for the EUS and has completed manufacturing and testing of several engines.



Artist concept SLS Block 1B crew with EUS cutaway

The SLS Team

SLS is America's rocket with more than 1,000 companies from across the U.S. and at every NASA center supporting the development of the world's most powerful rocket. The SLS Program, managed by NASA's Marshall Space Flight Center, works closely with the Orion Program, managed by NASA's Johnson Space Center, and the Exploration Ground Systems, managed at the Kennedy Space Center.

All three programs are managed by the Exploration Systems Development Division within the Human Exploration and Operations Mission Directorate at NASA Headquarters in Washington, D.C.

For more information about SLS, visit:

<http://www.nasa.gov/artemis>

<http://www.nasa.gov/sls>

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