National Aeronautics and Space Administration

Space Launch System

NASAfacts

America's Rocket for Deep Space Exploration

NASA's Space Launch System, or SLS, is an advanced 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 large cargo to the Moon on a single mission.

Offering more payload mass, volume capability and energy to speed missions through space than any current launch vehicle, 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 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.

The Power to Explore Beyond Earth's Orbit

To fill 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 at least 24,500 mph needed to break out of low-Earth orbit and travel to the Moon. That is about 7,000 mph faster than the space station travels around Earth.

Every SLS configuration uses the core stage with four RS-25 engines. The first SLS vehicle, called Block 1, can send more than 26 metric tons (t) or 57,000 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

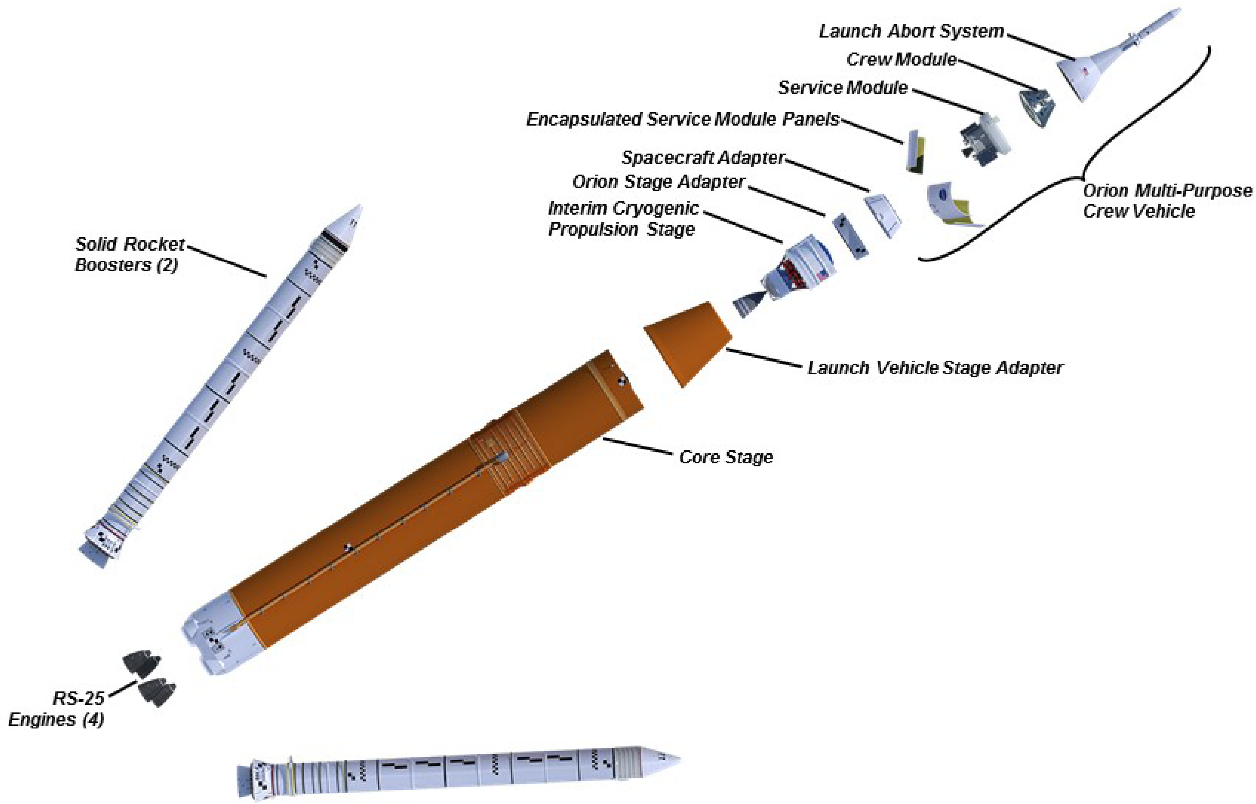
space, the Interim Cryogenic Propulsion Stage (ICPS) sends Orion on to the Moon.

The next planned evolution of the SLS, the 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 exploration systems like a deep space habitat module.

The Block 1B crew vehicle can send approximately 37 t (81,000 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 or science spacecraft on solar system exploration missions.

The next SLS configuration, Block 2, will provide 11.9 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 45 t (99,000 lbs.) to deep space. An evolvable design provides the nation with a rocket able to pioneer new human spaceflight missions.

Block 1 - Initial SLS Configuration



Space Launch System Missions

Exploration Mission-1 (EM-1), 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 EM-1, 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 teams prior to a crewed flight to send Orion to lunar orbit. SLS will also carry 13 small satellites, each about the size of a shoebox, that will be deployed in deep space.

Building the Rocket

NASA is building the rockets needed for the first and second 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 to build SLS. Some parts of the rocket are completely new. Other parts of the rocket have been upgraded with modern features that meet the needs of challenging deep space missions, which require higher launch vehicle performance levels than available using other existing rockets.

Core Stage

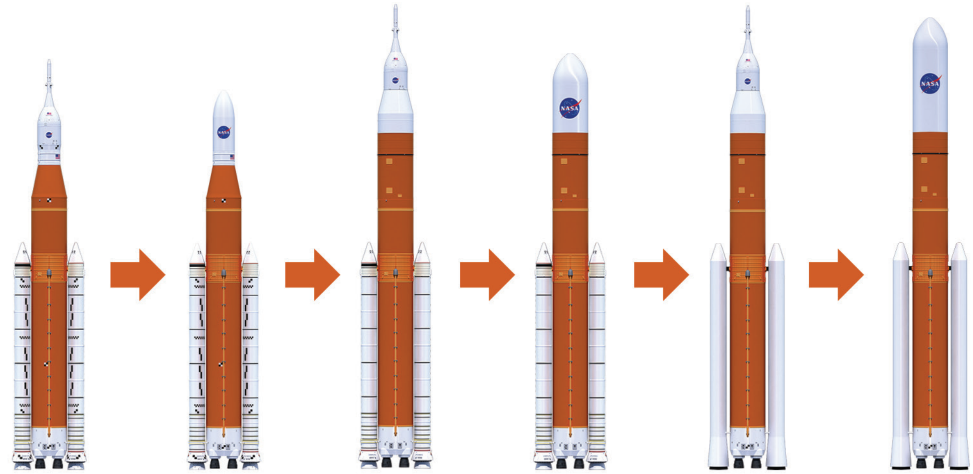
The Boeing Company, in Huntsville, Alabama, is building the SLS core stage, including the avionics that will control the vehicle during flight. Towering more than 200 feet with a diameter of 27.6 feet, the core stage will store 730,000 gallons of super-cooled liquid hydrogen and liquid oxygen that will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

The core stage is being 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.

All major structures are built and are being outfitted for EM-1, and Boeing has started building structures for EM-2. The SLS avionics computer software is being developed at NASA's Marshall Space Flight Center in Huntsville.

EM-1 Liquid Hydrogen Tank

SLS Evolution



	SLS Block 1 Crew	SLS Block 1 Cargo	SLS Block 1B Crew	SLS Block 1B Cargo	SLS Block 2 Crew	SLS Block 2 Cargo
Payload to TLI/Moon	> 26 t (57k lbs)	> 26 t (57k lbs)	34-37 t (74k–81k lbs)	37-40 t (81k–88k lbs)	> 45 t (99k lbs)	> 45 t (99k lbs)
Payload Volume	N/A*	9,030 ft^3 (256m^3)*	10,100 ft^3 (286m^3)*	18,970 ft^3 (537 m^3)	10,100 ft^3 (286 m^3)*	34,910 ft^3 (988 m^3)
Maximum Thrust	8.8M lbs	8.8M lbs	8.8M lbs	8.8M lbs	11.9M lbs	11.9M lbs

* Not including Orion/ Service Module volume

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

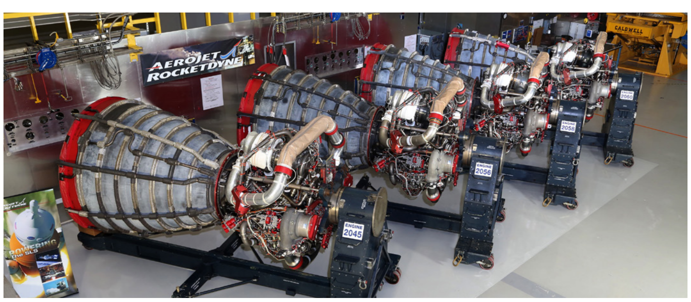
Propulsion for the SLS core stage will be provided by four RS-25 engines. Aerojet Rocketdyne of Sacramento, California, is upgrading an inventory of 16 RS-25 shuttle engines to SLS performance requirements, including a new engine controller, nozzle insulation and required operation at 512,000 pounds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

The engines for EM-1 are built, tested and ready for attachment to the core stage. After the engines are installed and the core stage is fully assembled, NASA's Pegasus barge will transport the entire stage to Stennis Space Center near Bay St. Louis, Mississippi, for green run testing. Then, Pegasus will take the core stage to Kennedy Space Center in Florida where it will be prepared for launch. Aerojet Rocketdyne has finished testing new controllers for EM-2 and has started development testing of new, advanced components to make the engines more affordable for future missions.

Boosters

Two shuttle-derived solid rocket boosters will be used for 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.

At the Utah facility, Northrop Grumman has cast all booster segments needed for EM-1 and started casting booster segments for EM-2. At Kennedy, engineers are refurbishing and upgrading space shuttle booster components to meet SLS requirements. Trains will carry booster segments from Utah to Kennedy Space Center where they will be stacked with other booster components. The boosters' avionics systems are being tested at Kennedy and Marshall.



EM-1 RS-25 Engines

EM-1 Solid Rocket Booster Segment

Spacecraft and Payload Adapter, Fairings and In-Space Stage

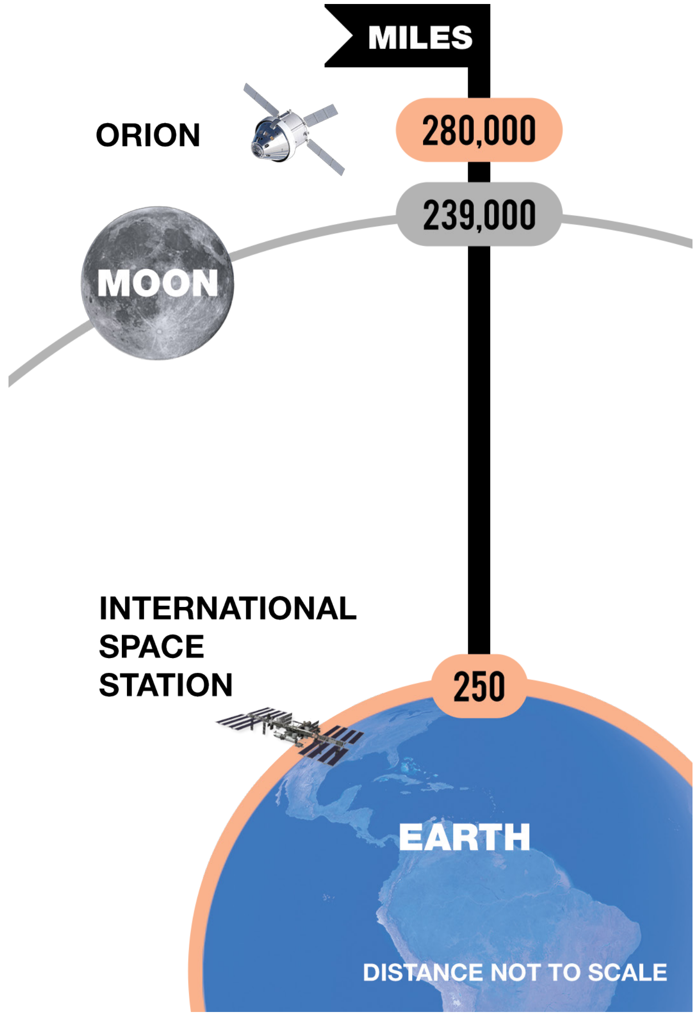
The Orion stage adapter will connect Orion to the ICPS on the SLS Block 1 vehicle and is the place where the small satellites will ride to space. The Orion stage adapter has been delivered to Kennedy for the first launch. Teledyne Brown Engineering of Huntsville, Alabama, has built the launch vehicle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

EM-1 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 Rockedyne. The engine is powered by liquid hydrogen and liquid oxygen and generates 24,750 pounds of thrust. This stage has been delivered to Kennedy and is ready for integration before launch.

EM-1 ICPS delivered to Kennedy Space Center



NASA's Space Launch System is powerful enough to send the Orion spacecraft beyond the Moon. For Exploration Mission-1, Orion will travel 280,000 miles from Earth—farther in deep space than any spacecraft built for humans has ever ventured.

The SLS Team

SLS is America's rocket with more than 1,000 companies from across the U.S. and every NASA center supporting the development of the world's most powerful rocket.

The SLS Program at Marshall works closely with the Orion Program, managed by NASA's Johnson Space Center in Houston, and the Exploration Ground Systems at Kennedy.

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

For more information about SLS, visit:

http://www.nasa.gov/sls/
http://www.twitter.com/NASA_SLS
http://www.facebook.com/NASASLS
http://www.instagram.com/exploreNASA

National Aeronautics and Space Administration

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

www.nasa.gov

FS-2018-08-084-MSFC