

King of rockets, NASA's SLS could soon be usurped by SpaceX's Starship

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Credit: Official SpaceX Photos via Flickr

NASA's Space Launch System roared off the launchpad at Kennedy Space Center and into the record books, for now.

The SLS [rocket](#), using a combination of two solid rocket boosters with a core stage consisting of four repurposed RS-25 engines from the [space shuttle program](#), produced 8.8 million pounds of thrust to lift the Orion spacecraft into orbit and help send it on its way to the moon for the uncrewed Artemis I mission.

Its success makes it the most powerful rocket to ever blast into [space](#), besting the power of the Saturn V rockets used during the Apollo moon missions five decades ago, which produced 7.5 million pounds of thrust.

The Soviet Union attempted to launch a rocket called the N-1 on four attempts from 1969-1972 that produced 10.2 million pounds of thrust, but they all failed midflight and never made it to space.

That makes SLS the space rocket king, and its performance was close to perfection, said NASA Artemis mission manager Mike Sarafin.

"I will simply say that the results were eye-watering. The rocket performed and or exceeded expectations," he said during a recent news conference.

The SLS design is similar to the approach of the space shuttle, the launches of which produced a little over 6.4 million pounds of thrust during their run from 1981-2011. Space shuttle launches, though, had only three RS-25 engines fed by fuel from the massive external fuel tank, while its two solid rocket boosters were not as tall as the SLS

versions, which string together in five segments instead of four.

Of note, the reusable RS-25s have all flown several shuttle missions including on Atlantis, Endeavour, Discovery and even one used on a previous Space Shuttle Columbia flight before it was destroyed in 2003 returning from orbit.

NASA touts SLS as the only rocket capable of transporting both crew and cargo for its deep-space destinations. A crewed Artemis II flight on an orbital moon mission is slated for no earlier than May 2024.

Artemis III, which looks to return humans, including the first woman, to the lunar surface for the first time since Apollo 17 in 1972 is scheduled for no early than the following year.

Beginning with Artemis IV, a larger version of the SLS using what NASA calls the Exploration Upper Stage, looks to cart parts of a small lunar space station called Gateway to help lay the groundwork for a continued presence at the moon. Beginning with Artemis IX likely not until the 2030s, a new version of the solid rocket boosters look to increase SLS's power to 9.2 million pounds of thrust at liftoff.

That future, though, could see Elon Musk's in-development Starship with Super Heavy booster for SpaceX not only take the title of most powerful rocket to make it to orbit but also be considered as an alternative for crew and cargo launch capability.

Using 33 of SpaceX's new Raptor 2 engines, the Super Heavy booster will produce 17 million pounds of thrust at liftoff, which is nearly double that seen, heard and felt on the Artemis I launch.

The Starship itself has six Raptor 2 engines, and will have the capacity to bring more than 220,000 pounds of crew and cargo to low-Earth orbit,

which is slightly more than the current SLS capacity.

The Starship and Super Heavy combination is gearing up for its first orbital test flight from SpaceX's facility Starbase in Boca Chica, Texas. It last performed a static fire on Nov. 14 with 14 of the engines with Musk posting to Twitter the [launch attempt](#) could be coming up before the end of this year.

The increasing cadence of Raptor static fires follows a July incident that left the booster in need of repairs when SpaceX lit up all 33, resulting in a fireball on the pad.

Combined, Starship and Super Heavy stand at 395 feet tall. SpaceX has stated it prefers to keep Starship test flights in Texas, but is also building out launch facilities for the next generation rocket at KSC, where it launches its current stable of Falcon 9 and Falcon Heavy rockets.

"SpaceX is moving at light speed to get the capability to conduct launch operations here," said Frank DiBello, president and CEO of Space Florida, the state's aerospace economic development agency. "So we're very optimistic that it won't be long."

But the first launch will be from Texas with Starship separating from the Super Heavy booster, which will land on a SpaceX vessel 20 miles offshore in the Gulf of Mexico. Starship then seeks to achieve orbit for at least one trip around the Earth and land in the Pacific Ocean. It's unclear how many test launches will take place from Texas before Florida operations get underway.

"It's a large vehicle, no question about it, and I think it will be a sight to see no matter where it launches from, but I expect the workhorse function of Starship is going to be conducted here," DiBello said. "That's our goal anyway. We're partnering with SpaceX to try to make that

happen."

NASA officials have a vested interest in Starship achieving operational status quickly as a version of it will be used for Artemis III. On that flight, astronauts will transfer from Orion into a Starship while orbiting the moon, and it's Starship that will bring them down to and back up from the lunar surface.

Last week NASA awarded SpaceX with the planned landing for Artemis IV as well, although future landers from other companies can continue to compete for Artemis contracts. With one test flight to the moon ahead of Artemis III required, SpaceX now has three lunar missions for NASA on the books.

"Much appreciated, SpaceX will not let NASA down!" wrote Musk on Twitter after the award announcement.

Musk was also congratulatory to NASA after Artemis I made its successful launch.

That launch actually knocked SpaceX's other big rocket—Falcon Heavy—from atop the list of most powerful active rockets. To date, SpaceX has only launched Falcon Heavy four times. The most recent occurred Nov. 1 from KSC, and that was the first in more than three years.

The first Falcon Heavy flight in 2018 was spectacle drawing hundreds of thousands to the Space Coast for a test flight that sent Musk's Tesla roadster into a deep-space orbit.

A Falcon 9 rocket produces 1.7 million pounds of thrust, and a Falcon Heavy is essentially three Falcon 9s strapped together to produce more than 5 million pounds of power.

From KSC's press site, the rumble of the Falcon Heavy makes car alarms go off just like when NASA launched the shuttles more than a decade ago. Falcon Heavy launches have the added treat of double sonic booms produced when SpaceX lands the two side booster stages at nearby Cape Canaveral Space Force Station.

The most recent launch and landing, which took place while KSC was blanketed in a fog, actually produced a shockwave that made clothing flutter while also bouncing an echo off the massive Vehicle Assembly Building that sounded like someone was lighting off bottle rockets.

While there was no sonic boom for the Artemis I launch, it provided amped-up sensations that dwarfed the power of Falcon Heavy.

The crowd's cheers began once they saw the smoke and flame from the Launch Pad 39-B a little more than three miles away followed by the growing roar about 10 seconds into flight that grew to a crescendo about 45 seconds after liftoff.

The pressure amassed in the ear like the muffled sounds of waking up from a dream, gaining steam until it became a crackling series of staccato punches to the senses. It could even be felt in the chest while the swelling cacophony of the distant burn of 1,500 gallons of propellant per second made spectators wonder just when it would stop.

The rumble lasted for more than two minutes with the crowd giving a little cheer halfway through before growing eerily quiet as the rocket continued to climb in altitude, then dialing back eventually to just a distant, faded hum. Then the crowd let loose again.

The Space Coast has a lot of little rumbles in the form of Falcon 9 and United Launch Alliance flights that regularly thrill rocket fans, on pace to launch more than once a week this year.

But those bigger rumbles remain few and far between. SLS won't fly again for at least another 18 months, although SpaceX does have a few Falcon Heavy launches on tap in the coming year, including the USSF-67 mission for the Space Force sometime in January.

That will have to hold down the rocket power fort until Artemis II lines up for launch for NASA or SpaceX sends Starship to the Space Coast.

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