National Aeronautics and Space Administration

NASAfacts

Constellation Program:

America's Fleet of Next-Generation Launch Vehicles

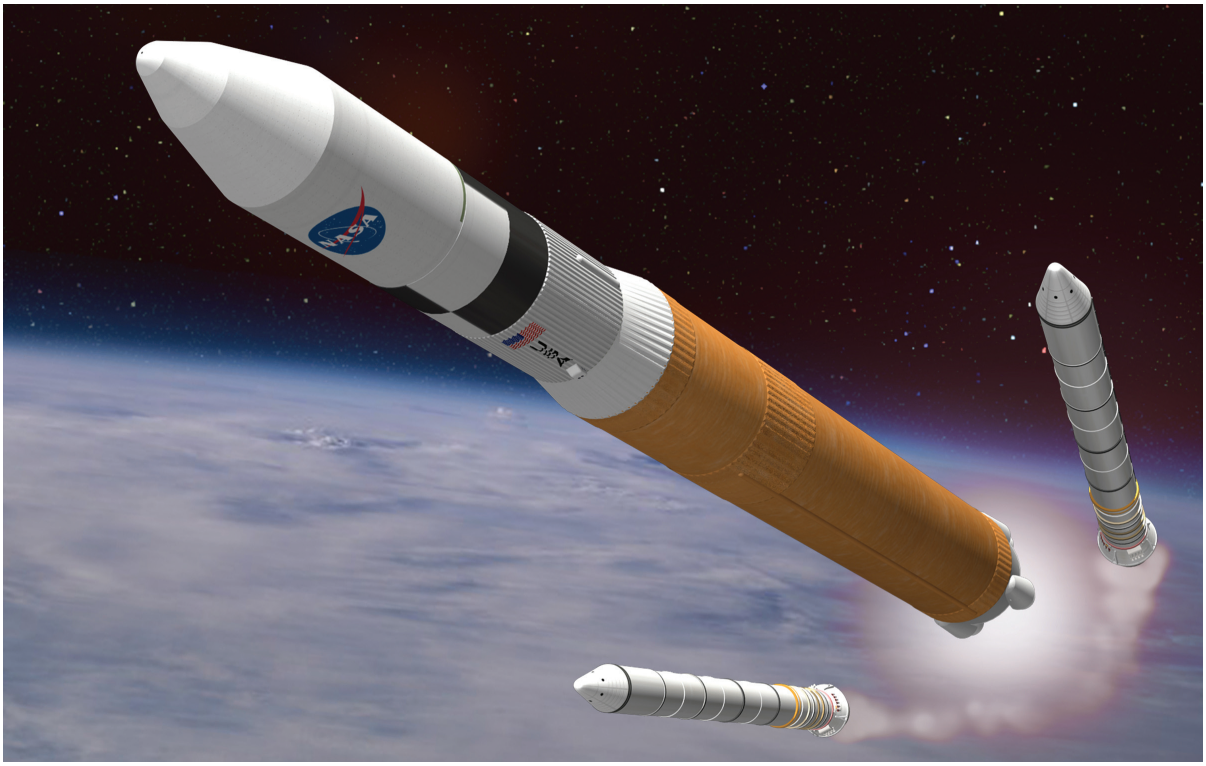
The Ares V Cargo Launch Vehicle

Planning and early design are under way for hardware, propulsion systems and associated technologies for NASA's Ares V cargo launch vehicle — the "heavy lifter" of America's next-generation space fleet.

Ares V will serve as NASA's primary vessel for safe, reliable delivery of resources to space — from large-scale hardware and materials for establishing a permanent moon base, to food, fresh water and other staples needed to extend a human presence beyond Earth orbit.

Under the goals of the Vision for Space Exploration, Ares V is a vital part of the cost-effective space transportation infrastructure being developed by NASA's Constellation Program to carry human explorers back to the moon, and then onward to Mars and other destinations in the solar system.

The Ares V effort includes multiple project element teams at NASA centers and contract organizations around the nation, and is led by the Exploration Launch Projects Office at NASA's Marshall Space Flight Center in Huntsville, Ala. These teams rely on nearly a half a century of NASA spaceflight experience and aerospace technology advances. Together, they are developing new vehicle hardware and flight systems and maturing technologies evolved from powerful, reliable Apollo-era and space shuttle propulsion elements.

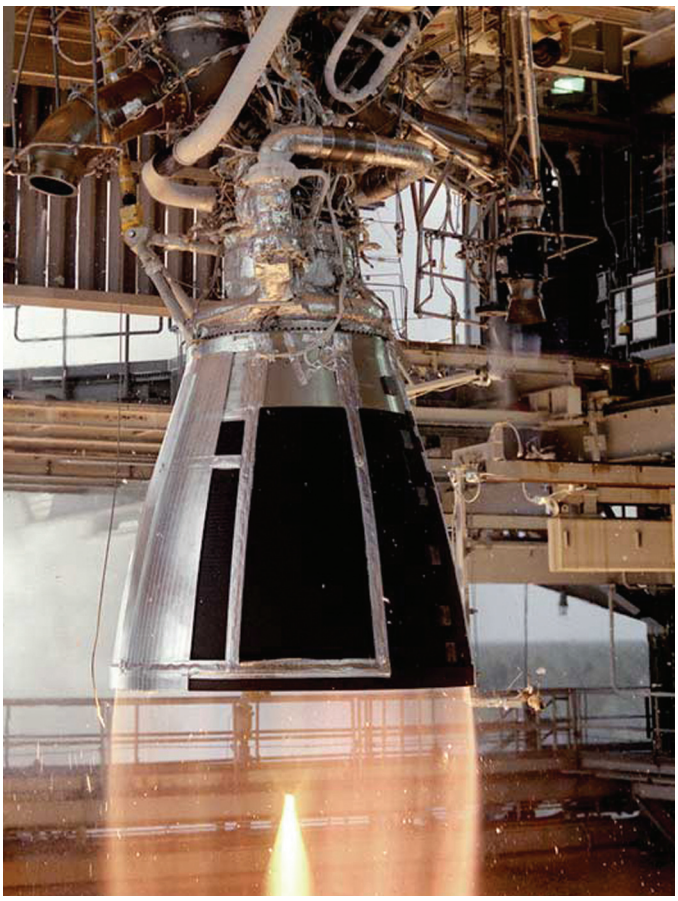


Concept image of Ares V in Earth orbit. (NASA/MSFC)

The versatile, heavy-lifting Ares V is a two-stage, vertically stacked launch system. The launch vehicle can carry about 290,000 pounds to low Earth orbit and 144,000 pounds to the moon.

For its initial insertion into Earth orbit, the first stage relies on two five-segment reusable solid rocket boosters. These are derived from the space shuttle solid rocket boosters and are similar to the single booster that serves as the first stage for the cargo vehicle's sister craft, the Ares I crew launch vehicle (see "Ares I" fact sheet). This hardware commonality makes operations more cost effective by using the same manufacturing facilities for both the crew and cargo vehicles.

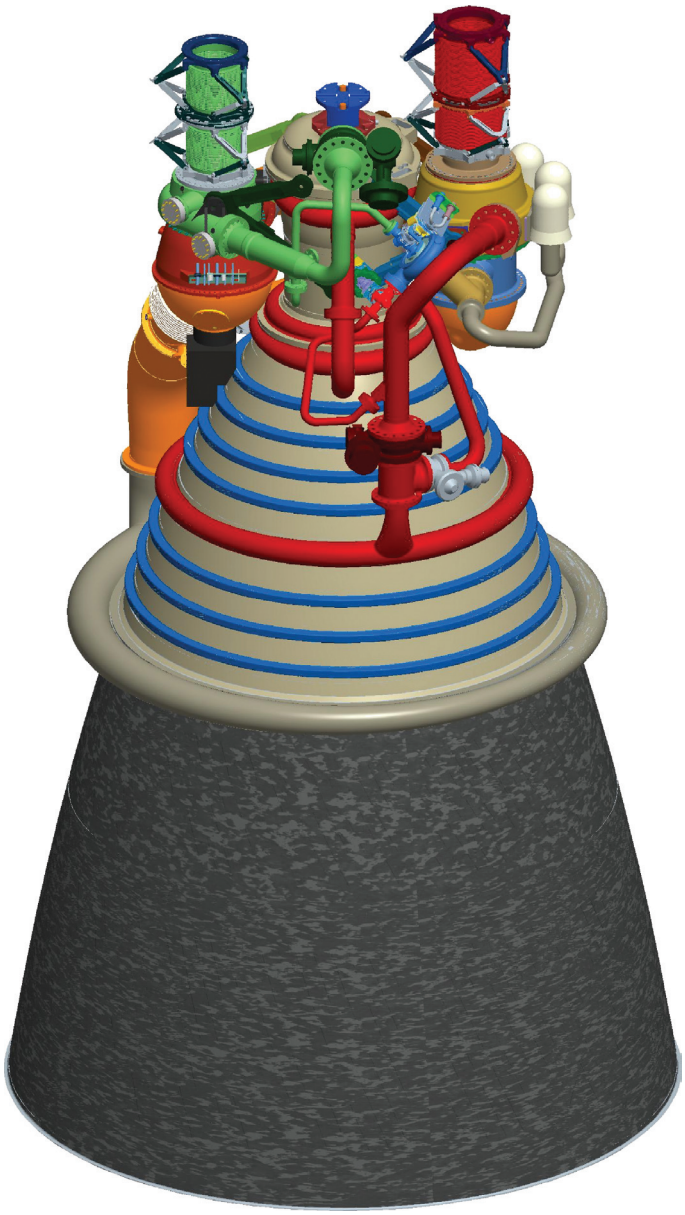
The twin reusable solid rocket boosters of the cargo lifter's first stage flank a single, liquid-fueled central booster element, known as the core propulsion stage. Derived from the Saturn V-class core, this central booster tank delivers liquid oxygen/liquid hydrogen fuel to five RS-68 rocket engines — an upgraded version of those currently used in the Delta IV, the largest of the Delta rocket family developed in the 1990s by the U.S. Air Force for its Evolved Expendable Launch Vehicle program and commercial launch applications. Together, these propulsion elements comprise the Ares V's first stage.



An RS-68 engine undergoes hot-fire testing at NASA's Stennis Space Center near Bay St. Louis, Miss., during the engine's developmental phase. (Pratt & Whitney Rocketdyne)

Concept image of Ares V elements. (NASA/MSFC)

Atop the central booster element is an interstage cylinder, which includes booster separation motors and a newly designed forward adapter that mates the first stage with the second, or Earth Departure Stage. This unique upper stage, being designed at Marshall, is propelled by a J-2X main engine fueled with liquid oxygen and liquid hydrogen. The J-2X is an evolved variation of two historic predecessors: the powerful J-2 upper-stage engine that propelled the Apollo-era Saturn 1B and Saturn V rockets to the moon and the J-2S, a simplified version of the J-2 developed and tested in the early 1970s but never flown.



Concept image of the J-2X engine. (NASA/MSFC)

Anchored atop the departure stage is a composite shroud protecting the lunar surface access module, which includes the descent stage that will carry explorers to the moon's surface and the ascent stage that will return them to lunar orbit to rendezvous with the Crew Exploration Vehicle for their return home.

During launch of an Ares V, the reusable solid rocket boosters and core propulsion stage power the vehicle into low-Earth orbit. After separation from the spent core stage, the Earth Departure Stage J-2X engine takes over, placing the vehicle in a circular orbit. The Crew Exploration Vehicle, carrying the astronauts, is delivered to space separately by the Ares I launcher, then docks with the orbiting Earth Departure Stage and its lunar module payload. Once mated, the Earth Departure Stage fires its engine to achieve "escape velocity," the speed necessary to break free of Earth's gravity, and the lunar vessel begins its journey to the moon.

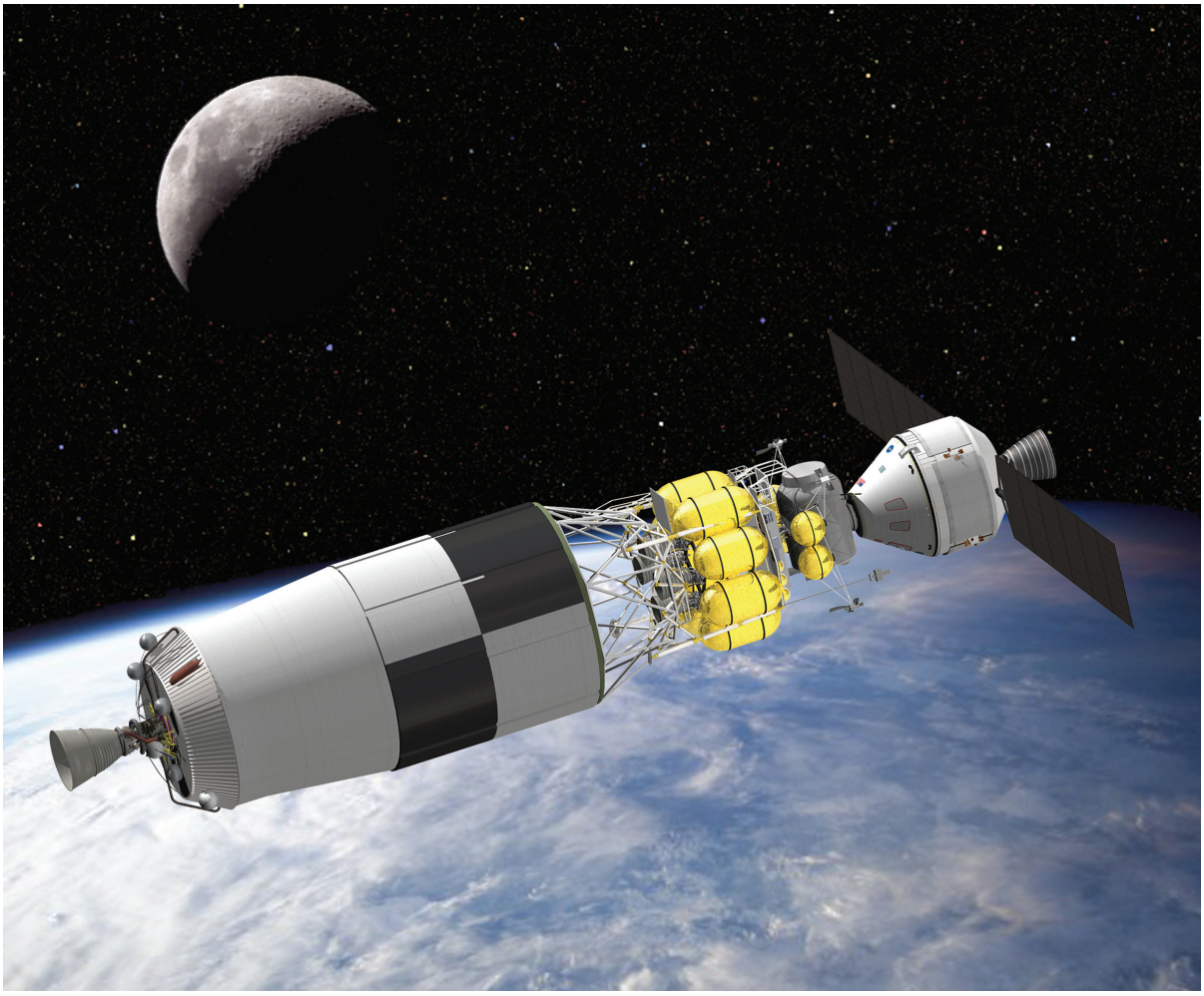
The Earth Departure Stage is jettisoned after it puts the mated crew and lunar modules on course for their lunar destination. Once the four astronauts arrive in lunar orbit, they transfer to the lunar module and descend to the moon's surface. The crew module remains in lunar orbit until the astronauts depart from the moon in the lunar vessel, rendezvous with the crew module in orbit and return to Earth.

The cargo vehicle's rockets can lift up heavy payloads, such as equipment and hardware, to Earth orbit or trans-lunar injection, a trajectory designed to intersect with the moon. Such lift capabilities will enable NASA to carry a variety of science and exploration payloads to space and, in time, undertake crewed missions to Mars and beyond.

The first crewed lunar excursion is scheduled for launch in the 2020 timeframe.

The Ares V effort and associated element project teams are led by the Exploration Launch Projects Office at Marshall, which reports to the Constellation Program Office at NASA's Johnson Space Center in Houston. Constellation is a key program of NASA's Exploration Systems Mission Directorate in Washington.

ATK Thiokol of Brigham City, Utah, is the prime contractor of the reusable solid rocket boosters. Pratt & Whitney Rocketdyne is the prime contractor for both the J-2X upper stage engine and the RS-68 main engine.



Concept image of the Ares V earth departure stage in orbit, shown with the Crew Exploration Vehicle docked with the Lunar Surface Access Module. (NASA/MSFC)

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