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Ares V: Refining a New Heavy Lift Capability

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Abstract

The Ares V cargo launch vehicle represents a significant new national commitment to expand human space exploration beyond low Earth orbit. Viewed more broadly, this new heavy-lift rocket will be an advancement over the national strategic capability lost when the Saturn V program ended more than three decades ago. The Ares V is one of two new launch vehicles being designed by NASA to support U.S. Space Exploration Policy. NASA selected the Ares I crew launch vehicle and the Ares V (Figure 1) during extensive independent and internal architecture and vehicle trade studies to complete the International Space Station, retire the current Space Shuttle fleet, return to the Moon by 2020, and journey to destinations beyond. These vehicles share components derived from the Apollo-era Saturn, Space Shuttle, and contemporary launch vehicle programs to provide safe, affordable, reliable, versatile sustainable space transportation to support national space goals for decades to come.

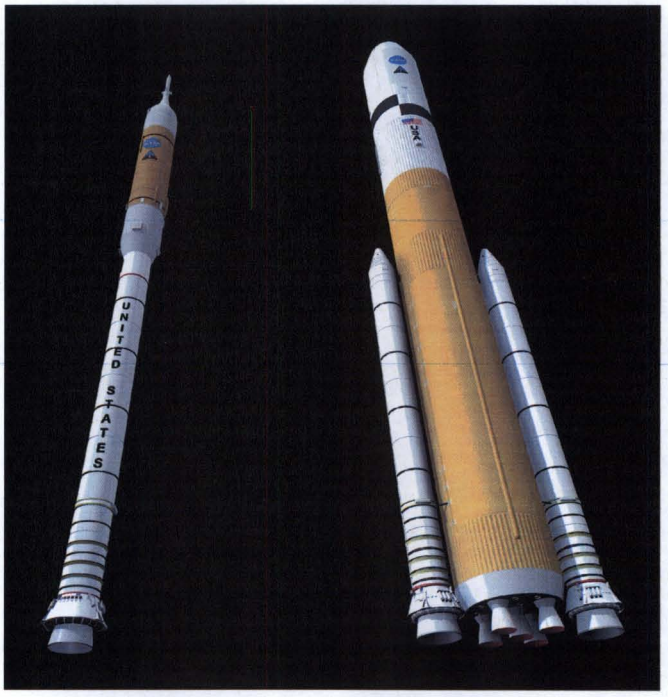

Figure 1. The Ares I (left) and Ares V (right) will form the backbone of America's new space fleet.

The Ares I will launch the Orion crew exploration vehicle, which can carry six astronauts to the space station or four astronauts for the lunar mission. The Ares V is designed to carry the Altair lunar lander into orbit, rendezvous with Orion, and send the mated spacecraft toward lunar orbit.

The heavy-lift Ares V will provide the unprecedented payload and volume necessary to go beyond the Apollo missions, establish a permanent lunar outpost, and open most of the Moon's surface to exploration and science.

Using the dual-launch Earth Orbit Rendezvous approach, the Ares I and Ares V together will be able to inject roughly 40 percent more mass to trans-lunar injection (TLI) than the Saturn V. Ares V alone will be able to put 316,000 pounds into low Earth orbit or 123,000 pounds directly to TLI, compared to 262,000 pounds and 99,000 pounds, respectively, for the Saturn V. That lift capability, combined with its planned 33-foot-diameter payload shroud, represent a national asset that offers new possibilities for the astronomy, military, and commercial communities.

The Ares V will be 360 feet tall, with a gross liftoff mass of 7.4 million pounds. Its first stage propulsion is provided by a LOX/LH_2 core stage powered by five RS-68 engines and a pair of five-segment solid rocket motors. Ares V's upper stage propulsion consists of a LOX/LH_2 Earth departure stage (EDS) powered by a single J-2X engine. Demonstrating the goals of heritage hardware and commonality, the motors are derived from the Space Shuttle's reusable solid rocket motors, and the J-2X is based on the Apollo-Saturn J-2 and later engines, including the Delta IV RS-68 engine. Both the motors and the J-2X engine are also used by the Ares I.

Work is well under way on development of the Ares I first stage and upper stage, as well as the Ares I-X flight test vehicle. While Ares I is NASA's top development priority to begin supporting Space Station operations following the Shuttle fleet retirement, important progress has been made in the Ares V to support a planned fiscal 2011 authority-to-proceed (ATP) milestone. The Ares Projects performed preliminary engineering analyses on the mission, trajectory, and design of the core stage in 2006 and early 2007. That work also included early analysis and testing on changes needed to upgrade RS-68 safety and reliability to support the NASA mission, as well as other national needs. Testing of new engine components is scheduled to begin this year. Ongoing analyses are examining on-orbit support for longer-duration loiter, payload shroud optimization and deployment, expanded use of composites in large structures, ground support requirements, and performance gains offered by additional engines and modifications to the boosters. Work also has begun on an Ares V Validation Study that will refine and integrate the results of separate studies on the core stage, EDS, boosters, and payload shroud. Due to the Ares V's commonality with the Ares I, it also benefits from current development and testing of the solid rocket motor and J-2X upper stage engine for the Ares I. This presentation will discuss the Ares V capabilities, including performance, payload volume, and design progress to date, as well as an update on development of the Ares I vehicle.