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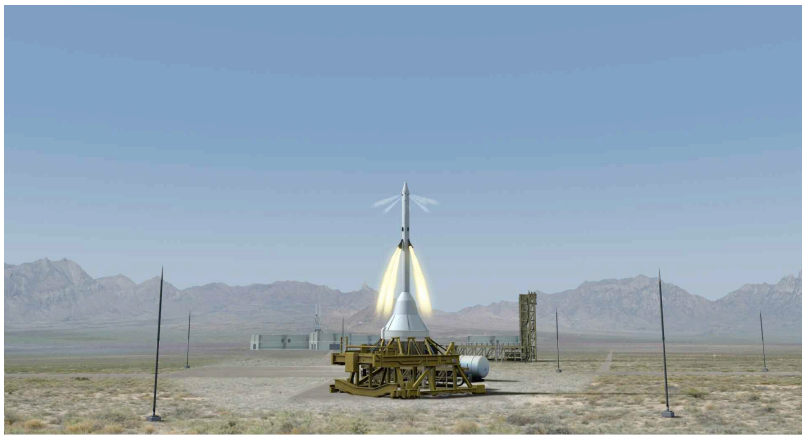
Constellation Program: Project Orion Abort Flight Test

A robust series of flight tests is planned for the rockets and spacecraft of NASA's Constellation Program, which will support International Space Station missions in the next decade, and will later enable human exploration of the moon.



Flight tests are where "the rubber meets the road" for America's new-generation spacecraft. All of the math, engineering and computer-aided design and development work will be put through real-world challenges that allow early correction of any design flaws and ensure the vehicles are safe for human use.

In the fall of 2008, Pad Abort 1 will begin a series of five launch abort system flight tests from the Orion Abort Flight Test Launch Complex being built at the U.S. Army's White Sands Missile Range near Las Cruces, N.M. Formal groundbreaking for the new facility occurred Nov. 14, 2007. The desert tests are part of a broader flight test campaign that also will include six launches from Kennedy Space Center in Florida.

White Sands Flight Tests

The White Sands flight tests will focus on the ability of Orion's launch abort system to pull the crew safely away from the launch vehicle in the event of a problem on the launch pad or during the climb into orbit. These critically important tests will assure that all components of the new safety feature work, and that Orion's parachute landing systems function as planned. These flight tests, along with other ground tests, will help managers certify Orion's new launch abort system for flight.

- Pad Abort 1 (PA-1): Tests the basic functionality of the launch abort system from the pad in its preliminary design configuration.
- Ascent Abort 1 (AA-1): Tests the ability of the launch abort system to function while the spacecraft is traveling through the period of maximum atmospheric drag.
- Pad Abort 2 (PA-2): Continues to refine the data collected on PA-1.
- Ascent Abort 2 (AA-2): Tests the ability of the launch abort system to function as the spacecraft breaks through the speed of sound.
- Ascent Abort 3 (AA-3): Tests the ability of the launch abort system to perform in the event it is tumbling due to a loss of control of the launch vehicle.

This project was reviewed for environmental compliance as required under the National Environmental Policy Act. NASA published an environmental assessment in August for public and regulatory agency review and received no adverse comments.

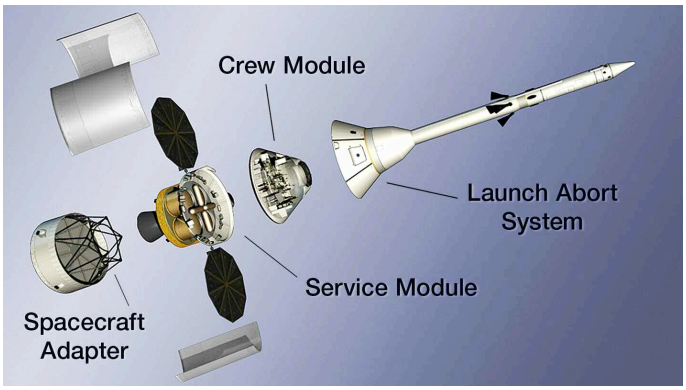
Sequence of Events

For the two pad abort tests, the launch abort system abort motor will be fired for two seconds, separating Orion mockup vehicles known as "boilerplates" directly from the launch pad to an altitude of about one mile. The boilerplates are actual size, shape and weight, but they do not contain seats, life support systems and other equipment.

For the three White Sands ascent abort test flights, former Peacekeeper missile rocket motors will be used to boost the boilerplate crew modules to high-stress conditions along planned launch trajectories at different altitudes in order to mimic realistic abort conditions.

During all of the White Sands test flights, the launch abort system's directional control rockets and steering canards will actively steer the crew module after an abort is initiated. As the modules approach the apex of their trajectories, a programmed sequence of events will occur.

First, explosive bolts fire, separating the spent launch abort system rocket from the crew module, clearing the module's recovery parachute system to activate. Next, as the module begins its descent, two mortars fire small drogue parachutes upward into the airstream. The drogues pull out the three main parachutes, each 116 feet in diameter, for a safe landing.



Launch Abort System

The launch abort system, mounted on top of the Orion crew module, centers around three solid propellant rocket motors: an abort motor; an attitude control motor; and a jettison motor.

The abort motor is a 500,000-pound-thrust primary motor designed to lift the crew module off the Ares I booster rocket and fly it away safely.

The attitude control motor, composed of several small nozzles ringing the launch abort system, fires simultaneously to keep the crew module on a controlled flight path. The system also incorporates steering vanes for additional directional control.

The jettison motor discards the abort system and boost protective cover from the crew module in order to allow the recovery parachute system to be deployed.

The launch abort system must be ready to operate in a wide variety of different environmental conditions, and the test program is designed to test all of these conditions.

Team Effort

NASA's Orion project office at NASA Johnson Space Center is leading a government and contractor team to validate and verify the spacecraft's launch abort system.

The launch abort system flight test effort is led by NASA's Dryden Flight Research Center. Boilerplate crew module integration will occur at the center for the first two flights. Integration of the crew module boilerplates for the remaining flights will occur in the Orion Assembly Integration and Test facility at NASA's Kennedy Space Center.

Lockheed Martin Corp. is NASA's prime contractor for the Orion spacecraft and its launch abort system. Orbital Sciences Corp., Dulles, Va., is building the launch abort system under contract to Lockheed Martin. NASA has a cooperative agreement with the U.S. Air Force to procure the abort test boosters that will serve as the launch vehicle for the Orion ascent abort flight tests. Orbital is also building the abort test boosters and providing launch support services under contract to the Air Force.

The NASA Langley Research Center leads the launch abort system integration effort and is fabricating the crew module boilerplates used for the first two abort flight tests. NASA's Glenn Research Center near Cleveland, Ohio, is providing a test-unique cold gas reaction control system. NASA's Marshall Space Flight Center in Huntsville, Ala., is providing solid rocket booster engineering and operations expertise.

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