NASAfacts

Constellation Program:

Astronaut Safety in a Launch Emergency

The Orion Launch Abort System

When astronauts rocket to the moon aboard NASA's Orion crew exploration vehicle, they will lift off in a spacecraft that can escape safely should a malfunction in the launch vehicle occur.

The Orion launch abort system (LAS) will offer a safe, reliable method of pulling the entire crew out of danger in the event of an emergency on the launch pad or during the climb to Earth orbit.

Mounted at the top of the Orion and Ares I launch vehicle stack, the abort system will be capable of automatically separating the spacecraft from the rocket at a moment's notice and setting the stage for a safe landing.

Making its first flights early in the next decade, the Orion/Ares I launch system is being developed by the Constellation Program as it prepares to send human explorers back to the moon, and then onward to Mars and other destinations in the solar system.

Launch Abort Sequence

If a launch pad or in-flight emergency occurs, the abort and attitude control

Orion's launch abort system is designed to pull the crew module to safety in an emergency.

motors will ignite, pulling the Orion crew module safely free of the Ares I launch vehicle. The abort motor will generate 400,000 pounds of thrust in a fraction of a second, rapidly pulling the crew to safety while the attitude control motors maintain stability.

After the vehicle is safely away from the booster, the attitude control motor will reorient the capsule before the crew module is released from the abort system to begin its controlled descent. Following a sequence appropriate to the time and location of the abort, the same parachutes used for a normal landing will open above the crew module and help guide it to Earth's surface. The launch abort system will not be recovered.

The launch abort system is a key element in NASA's continuing efforts to improve space flight safety as it develops vehicles for the future of exploration. Orion's launch abort system carries the heritage of the Apollo abort system, but advances the concept to provide protection in a broader range of situations. The space shuttle does not have a launch abort system because the spacecraft is mounted side-by-side to its solid rocket boosters and external tank.

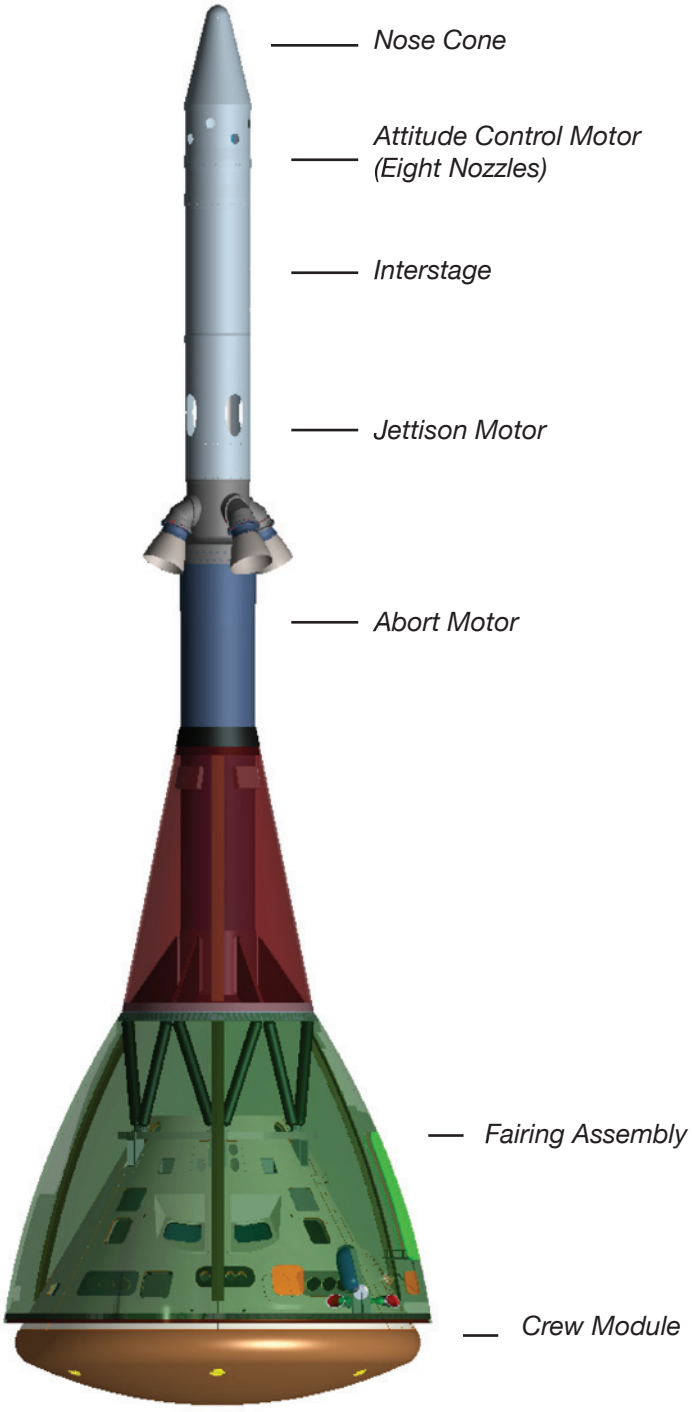
Components

The various components of the launch abort system include a fairing assembly that covers the crew vehicle, a motor stack and a nose cone. When separated from the launch vehicle during an abort, the launch abort system and Orion crew vehicle together are called the launch abort vehicle (LAV).

The fairing assembly will enclose the crew module to protect it from atmospheric debris, aerodynamic pressure and heating and abort motor exhaust plumes, and will attach the launch abort system structure to the crew module.

The motor stack consists of three solid propellant motors that will perform the abort, attitude control and jettison functions.

The abort motor will provide the thrust needed to pull the crew safely away from the Ares I stack in an emergency. It will use four exposed, reversed flow nozzles to provide the initial abort impulse. An attitude control motor composed of eight nozzles will orient the abort vehicle as it pulls away from the launch vehicle.



The motor stack also includes a jettison motor consisting of four aft, scarfed nozzles designed to be flush with the contour of the vehicle that will propel the launch abort system away from the crew vehicle during a normal launch or once a launch abort has occurred.

The nose cone, located at the top of the launch abort system, is designed with a curved shape, making the vehicle aerodynamic as it travels through the atmosphere.

Testing

NASA and its partners are conducting tests on the various components of the launch abort vehicle to determine the best and safest configuration in preparation for the first crewed mission, scheduled for no later than 2015. The first lunar excursion is scheduled for the 2020 timeframe.

A series of unmanned abort tests will begin in 2009 at the U.S. Army's White Sands Missile Range in New Mexico, and subsequently at NASA's Kennedy Space Center in Florida.

Tests at White Sands and Kennedy will enable Orion spacecraft developers to verify that the launch abort systems can safely execute an abort and recovery sequence during pre-launch countdown and during critical phases of an ascent abort. The tests will also identify potential risks and challenges so that NASA can incorporate those findings into future designs. The abort system will be instrumented to acquire aerodynamic and systems performance data.

To demonstrate the ability of the system to provide launch pad escape capability, two pad abort tests, known as PA-1 and PA-2, are scheduled. The first pad abort test will be followed by ascent abort tests and the second pad abort test. These tests will provide early data for the design reviews to follow. The first pad abort flight will test whether all of the launch abort system components can function properly as a system. The second pad abort test will incorporate any design changes resulting from the pad and ascent abort test sequence and will verify that the launch abort system is capable of meeting its performance requirements.

During these pad abort tests, an abort command will be sent from the mobile operations center. This will ignite the launch abort system motor. Burning for approximately two seconds, the motor will propel the launch abort vehicle safely away from the launch pad. The launch abort system and crew module will separate, and the crew module will land approximately one mile from the launch pad after about one minute aloft.

Ascent abort tests are planned to verify safe abort performance during critical phases of the Ares I ascent profile. Each test will have varying test conditions, with the abort command issued either manually from a command uplink from the ground or autonomously by the crew module avionics computers as the launch vehicle enters the critical test window. The White Sands ascent abort tests will employ an abort test booster, which is a retired Peacekeeper missile stage, designed to propel the Orion test elements to the required abort test conditions.

Tests conducted in NASA Langley Research Center's 20-Foot Vertical Spin Tunnel help researchers better understand the dynamic stability of the launch abort vehicle.

Partners

The Orion Project Office, located at NASA's Johnson Space Center in Houston, is leading development of

all facets of the Orion spacecraft for the Constellation Program.

Development of the Orion launch abort system is being led by the Exploration and Flight Projects Directorate at Langley Research Center in Hampton, Va., on behalf of the Orion Project. Marshall Space Flight Center in Huntsville, Ala., is Langley's partner in developing the launch abort system.

Constellation Program element development is a joint effort involving every NASA center and is organized under the leadership of NASA's Exploration Systems Mission Directorate in Washington. Lockheed Martin Corp. is NASA's prime contractor for design, development, testing and construction of Orion, including the launch abort system.

Dryden Flight Research Center at Edwards Air Force Base, Calif., is leading abort flight test integration and operations, including procurement of the abort test booster. The Air Force Space Development and Test Wing at Kirtland Air Force Base, N.M., is assisting Dryden in the development and production of the abort test booster using its Sounding Rockets Program contracts.

Marshall's primary launch abort system responsibilities are in the areas of integration and contractor management, as well as overseeing solid rocket propulsion, structures and safety and mission assurance. Marshall also will play a key role in abort test booster assessments.

Langley is designing and producing the crew module flight test articles for the first pad abort and the first ascent abort. Lockheed Martin will design and produce the crew module flight test articles for all subsequent abort flight tests.

NASA's Glenn Research Center in Cleveland, Ohio, will conduct thermal, acoustic and mechanical vibration and electromagnetic compatibility testing on the launch abort system and the fully assembled spacecraft.

If an in-flight emergency occurs during ascent, the launch abort system will pull the Orion crew module safely free of the Ares I launch vehicle.

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FS-2008-11-156-LaRC