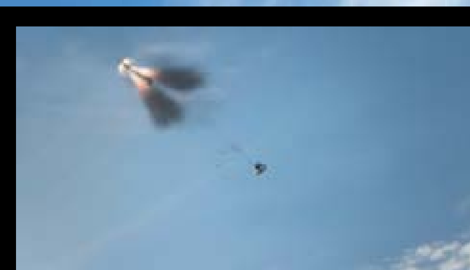
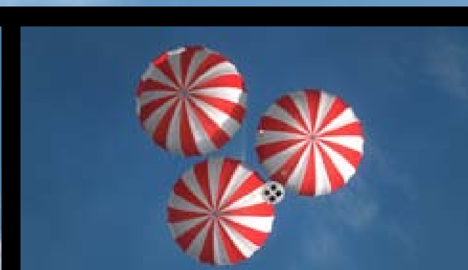
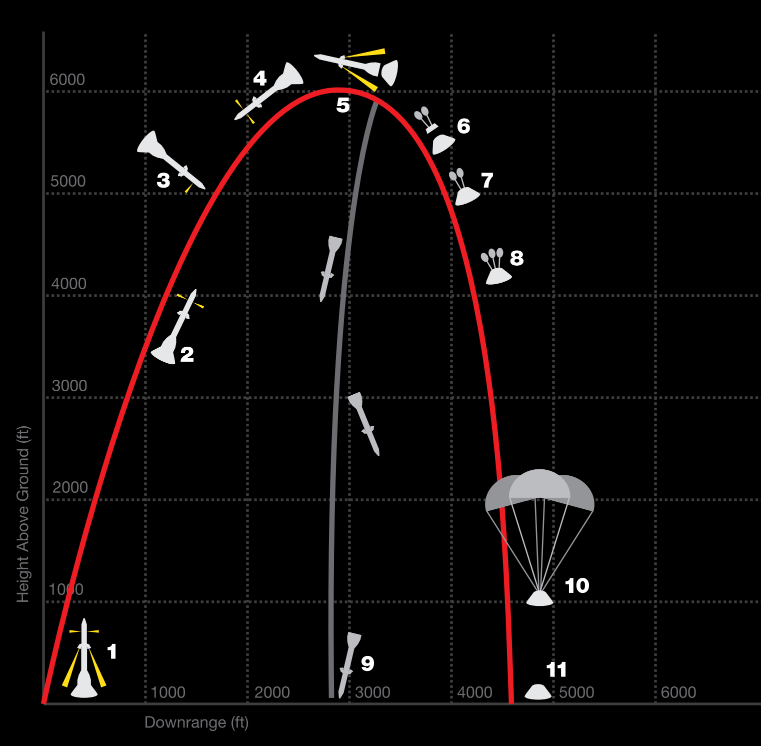
National Aeronautics and Space Administration

ORION PA-1
2010







Pad Abort-1 is a NASA flight test of a system that could be used to rescue a crew and its spacecraft in case of emergencies at the launch pad.

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PA-1 Trajectory Overview:

	Time (In Seconds)	Event
1	0.00	Abort Motor (AM) and Attitude Control Motor (ACM) Ignition
2	6.45	AM Burnout
3	10.05	ACM Begins Vehicle Reorientation
4	15.77	End Reorientation
5	21.03	Launch Abort System (LAS) Jettison
6	22.02	Forward Bay Cover Jettison
7	24.56	Drogue Parachutes Deploy
8	30.56	Pilot Parachutes Deploy
9	49.32	LAS Touchdown
10	52.54	Reach 33 ft/sec
11	96.83	Crew Module Touchdown

NASA's latest flight test, called Pad Abort 1 (PA-1), will be conducted at the Orion Abort Flight Test Launch Complex 32E at the U.S. Army's White Sands Missile Range (WSMR) near Las Cruces, N.M.

Although it is a component of the agency's Constellation program and Orion crew exploration vehicle, the future of which is currently under deliberation in the U.S. Congress, the test will be conducted as part of NASA's ongoing mission to develop safer space vehicles for all human spaceflight applications. Information gathered through PA-1 testing will be valuable in design and development of future systems built for use in providing emergency egress for space crews and vehicles. The launch abort system, or LAS, is designed to activate within milliseconds in the event of an emergency on the launch pad or during initial ascent. It consists of three motors: the abort motor that fires nearly 500,000 pounds of thrust to pull the crew module up and away from the launch vehicle; the attitude control motor that exerts up to 7,000 pounds of steering force to reorient the vehicle's position; and the jettison motor that separates the crew module from the launch abort system so that parachutes can be deployed for a safe landing.

Testing the LAS performance and LAS to crew module interface are the principal objectives of PA-1. The integrated LAS system performance cannot be adequately tested except in abort flight test conditions such as PA-1. The information gathered from the test also will help reduce uncertainties in the models and analysis, thereby removing excess conservatism and improving safety.

Some of the primary objectives are to:

- Demonstrate ground-initiated abort;
- Demonstrate the capability of the LAS to propel the module to a safe distance from a launch vehicle during a pad abort;
- Demonstrate stability and control characteristics of a crew module in regards to the LAS;
- Obtain LAS/crew module interface structural loads and external acoustics data;
- Determine the performance of the abort, jettison and attitude control motors;
- Demonstrate abort event sequencing from abort initiation through LAS jettison.

Secondary objectives of the test are to:

- Demonstrate parachute assembly system event sequencing;
- Demonstrate the performance of the main parachute system.

This data will have wide applicability to future launch vehicles and will also demonstrate the performance of three new types of motors and innovations in their design.

1. Attitude Control Motor

The LAS employs an attitude control motor that provides precision control of flight buy utilizing a variable high-thrust rocket technology that eliminates heavy ballast, aerodynamic canards and reliance on static aerodynamic stability without control that were used in Apollo designs. The technology heritage of the attitude control motor is related to missile steering systems, but has never been produced at this large scale (the attitude control motor is 32 inches in diameter). The ACM development employs advanced high-temperature, high-pressure and high-strength composite materials technologies that are adaptable to future space exploration applications.

2. Jettison Motor

The jettison motor has scarfed nozzles and is configured similarly to the Apollo jettison motor, although it is much bigger to accommodate the increased mass and performance of the Orion LAS. Because the jettison motor is used to jettison the LAS in both the nominal scenario and emergency abort situations, its function must be extremely reliable.

3. Abort Motor

The abort motor has advanced the state of knowledge in rapid burn fuels, reverse flow solid rocket motor designs, composite casing, and direct strike lightning protection technologies adaptable to future exploration applications. It uses a high strength-weight graphite/epoxy composite motor case and igniter. Computational fluid dynamics were extensively used to design a novel electron-beam welded 4340 steel manifold and reverse flow nozzles. This geometry places the abort motor plume farther from the crew module, eliminating the need for a tower structure used in the Apollo configuration. These innovations minimize mass and maximize payload.

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