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NESC 2014 Technical Update

Launch Abort System Evolution

A critical component of crewed spacecraft, the launch abort system (LAS), allows for rescue of the crew in the event of a catastrophic malfunction while the spacecraft is sitting on the launch pad or on its way into orbit. For a successful rescue, however, the LAS must perform several critical maneuvers in rapid-fire succession. First, the launch abort motors must be powerful enough to fly the fairing and crew module (CM) to a safe distance away from the launch vehicle. Next, it must reorient and fly in a carefully controlled heat shield-forward attitude. Finally, it must release the CM, enabling the CM's parachute landing system to deploy for a safe return of the crew.

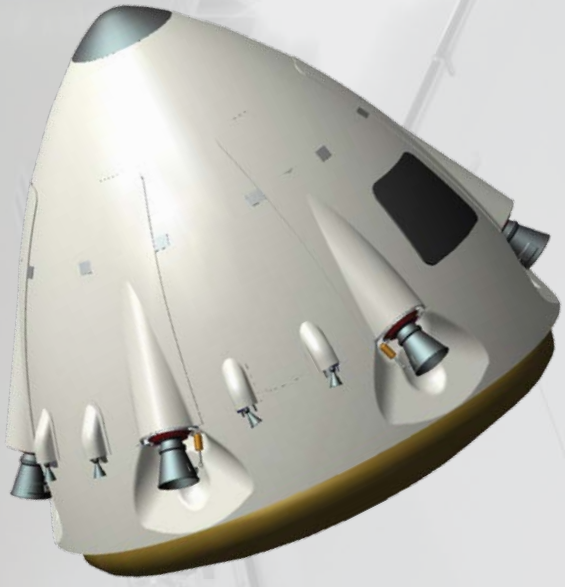
LAS begins with Project Mercury

Since the time of Project Mercury and the Apollo Program, the LAS has maintained its traditional tower configuration. But as spacecraft design has evolved, so has the need for a new LAS. The Orion Multi-Purpose Crew Vehicle launched on December 4, 2014, featured a new Alternative Launch Abort System (ALAS) shape and structure that enhanced the aerodynamic and aeroacoustic performance of the spacecraft. But while the NESC was spearheading efforts on the ALAS design, it was also developing the Max Launch Abort System (MLAS), a follow-on to the ALAS design that incorporated the ALAS shape while fundamentally changing the LAS from a tower to a towerless design.

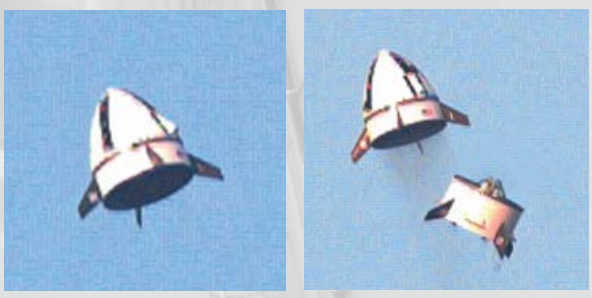
Named in honor of Maxime Faget, developer of the original Mercury launch escape system, MLAS was a 2-year effort that culminated in a full-scale flight demonstration. The initial goal of MLAS was to keep the ALAS advantages while pursuing a LAS concept that eliminated the tower and did not require active attitude control or stabilization following escape motor burnout. A key design constraint was avoiding structural changes to the CM if MLAS was substituted for the launch abort tower.

From napkin sketch to flight test

From a napkin sketch design drawn by the NASA Administrator at the time, which featured six side-mounted escape motors attached to the service module, the NESC team focused on key issues such as the number and placement of motors, separation dynamics, stability following motor burnout, and CM extraction from the fairing. This concept became the basis for the MLAS flight test vehicle, which would be boosted to abort test conditions to prove MLAS was passively stable, could be reoriented with parachutes, and safely release the CM for crew recovery. Launched from NASA Wallops Flight Facility in July 2009, the MLAS successfully demonstrated all flight test objectives.



Propulsively stabilized MLAS concept.



Left: Successful launch abort test of the passively stabilized MLAS flight test vehicle. *Right:* Spent test booster can be seen falling away after launch.

During the flight test, dummy motors were incorporated into the MLAS fairing alongside the CM. This preserved space for the next flight test concept, which was to use the six abort motors with thrust vector control to perform active stabilization and eliminate the large exterior fins used on the first flight test. Thrust vector control would allow the MLAS to steer in the best direction for safety during the boost phase of an abort, then reorient for safe release of the CM. This MLAS objective system design was completed to a point where it could be built and tested if needed in the future.

More than 150 people from across NASA, as well as industry partners, had a hand in bringing the MLAS flight test to fruition, not only meeting the mission objectives, but developing and building a full-scale prototype vehicle from which invaluable experience was gleaned for future NASA projects. □