

Lockheed Martin P-791 airship

Peter Lobner, 1 May 2019

Background

Starting in the 1990s, Lockheed Martin's Advanced Development Programs (the Skunk Works) in Palmdale, CA, studied various concepts for large, cargo-carrying airships.

In mid-2005, Lockheed Martin and Aeros Aeronautical Systems Corp. (Aeros) were selected as the two contractors to conduct Phase I of DARPA's Project Walrus, which sought to develop new technologies and design concepts for a strategic, heavy-lift cargo airship. At that time, work on the P-791 already was in progress.

The P-791 technology demonstrator

The P-791 is a 120 foot (36.6 meter) long, tri-lobe, semi-buoyant hybrid airship that serves as a sub-scale demonstrator for future Lockheed Martin hybrid airships. It is heavier-than-air and flies under the combined influence of the buoyant lift from helium, vectored thrust from propellers, and aerodynamic lift from the hull and fins when in forward flight. The flexible composite fabric hull (the gas envelope) is slightly pressurized to maintain its aerodynamic shape. The P-791 is not designed for vertical takeoff and landing (VTOL) or hover, since flight depends on some aerodynamic lift being generated by the hull.

The P-791 is designed for short takeoff and landing (STOL) and ground operations at unimproved sites using its air cushion landing system (ACLS). During takeoff and landing and when the P-791 is moving on the ground, the ACLS operates in "lift" mode. The four air cushion pads on the bottom of the airship allow it to float on cushions of air while using the vectored thrust propulsion system to move the airship over almost any type of surface (pavement, unimproved natural surface like dirt, sand, snow or ice or water).



Stern quarter view of the P-791 in its hanger showing the rear fins and one of two stern vector thrust units.

Source: Al Sieb / Los Angeles Times / TNS



Bow view of the P-791 showing the tri-lobe hull design and the two bow vector thrust units.

Source: Screenshot from Lockheed Martin video.

The ACLS fans can be reversed and operated in “suction” mode, which enabled the airship to “grip” a solid surface and remain stationary during ground cargo handling or in windy conditions without the need for ground-based mooring / docking hardware. Operating the ALCS in suction mode helps compensate for changes in airship gross weight during load exchanges. It may still be necessary to adjust ballast before flight to compensate for the addition or removal of heavy loads.

You can see a short video on the operation of the ACLS here:

https://www.youtube.com/watch?v=Qi_sJ-k3kRI

Flight operations

The first flight of the P-791 took place on 31 January 2006 at Lockheed Martin’s facility in Palmdale, CA. You can see a short video on the P-791 at the following links:

<https://www.youtube.com/watch?v=CKAyJ3zKTus>

Airship magazine reported that the P-791 flew six times. Lockheed Martin claimed that all flight test objectives were successfully achieved.



*P-791 in flight.
Source: Lockheed Martin*



*P-791 showing the four ALCS units under the fuselage.
Source: Lockheed Martin*

The Lockheed Martin P-791 hybrid airship served as the basis for the design of a larger airship intended for the U.S. Army's Long Endurance Multi-Intelligence Vehicle (LEMV) program, which was won in 2010 by the Northrop Grumman / Hybrid Air vehicles (HAV) team with their HAV-304 hybrid airship.