Hybrid Air Vehicles (HAV) - Airlander 10 & 50 airships

Peter Lobner, Updated 24 August 2021

1. Introduction

Hybrid Air Vehicles (HAV) was formed in the UK in 2007 after a series of business failures by its predecessor firms, Advanced Technologies Group (ATG) and SkyCat Group Ltd. In the process, HAV acquired the rights to ATG’s hybrid airship and blimp technologies dating back to about 1999. The HAV website is here: https://www.hybridairvehicles.com/about-us

HAV’s Facebook page here: https://www.facebook.com/pg/HybridAirVehicles/posts/

2. The Airlander 10 prototype

The Airlander 10 prototype airship is the commercial reincarnation of the HAV-304 LEMV airship with minor modifications to improve its performance, including larger upper fins with leading edge extensions and shorter side strakes.

A model of the Airlander 10. Source: The Verge, 8 July 2014
After removal of all military equipment and systems, HAV was able to purchase the HAV-304 airship as scrap at a price of $301,000, gain an export license and ship it to the UK. In early 2015, HAV re-inflated a gas envelope with pressurized air inside a Hangar at Cardington.

*Front quarter view of the former HAV-304 inflated with air in Hangar 1 at Cardington. Source: The Verge, 8 July 2014*

*One of the flank-mounted diesel-powered vectoring thrusters. Source: The Verge, 8 July 2014*
Left: The cockpit is at the front of the elongated payload module suspended under the centerline of the gas envelope.
Right: The pilot and copilot stations.
Source: The Verge, 8 July 2018

Close-up view of the assembled Airlander 10 prototype in 2016 showing a flank-mounted vectored-thrust propulsor and one of the landing skids. Source: Philbobagshot / Wikipedia
Stern quarter view of the Airlander 10 prototype sitting on its inflated skids in Hangar 1 at Cardington. Source: The Airship Heritage Trust

Bow-on view of the Airlander 10 prototype sitting on its inflated skids in Hangar 1 at Cardington with the rigid mission module being attached to the aeroshell. Source: Philbobagshot / Wikipedia
Basic design characteristics of the prototype are summarized below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prototype Airlander 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Semi-rigid, hybrid</td>
</tr>
<tr>
<td>Length</td>
<td>302 feet (92 m)</td>
</tr>
<tr>
<td>Width</td>
<td>143 feet (43.5 m) at its tail fin tips</td>
</tr>
<tr>
<td>Height</td>
<td>85 ft (26 m)</td>
</tr>
<tr>
<td>Gas envelope volume</td>
<td>1,342,000 ft³ (38,000 m³)</td>
</tr>
<tr>
<td>Gross weight</td>
<td>44,100 lb (20,000 kg)</td>
</tr>
<tr>
<td>Payload</td>
<td>3 metric tons (3,000 kg, 6,612 lb) payload to an altitude of 10 - 14,000 feet (3,048 – 4,267 m)</td>
</tr>
<tr>
<td>Powerplant</td>
<td>4 x 4-liter V8 turbocharged diesel engines @ 325 hp (242 kW) each</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>80 kts (148 kph)</td>
</tr>
<tr>
<td>Maximum altitude</td>
<td>16,000 feet (4,880 m)</td>
</tr>
<tr>
<td>Maximum mission duration</td>
<td>Five days</td>
</tr>
</tbody>
</table>


The Airlander 10 prototype made its first two flights on 25 August 2016 from Cardington Airfield. The first flight went well.
Close-up of the cockpit and one flank propulsor.

Close-up of one stern propulsor.

Source, both photos: The Airship Heritage Trust
The second flight on 25 August 2016 ended with an inauspicious soft crash landing with some damage to the airship and cockpit, but no injuries to the crew.
Airlander 10 prototype soft crash landing after second flight.
Source: Sky News

The Royal Aeronautical Society’s report on the first half of the Airlander 10 testing program indicated that the all-weather capability of the Airlander 10, including anti-icing, would be tested in the second half of the test program. The report suggested that the commercial Airlander 10 may have a more powerful thrust vectoring system that will enable a (limited) VTOL capability. You’ll find this report, “Expanding the Envelope,” at the following link:

HAV carried out six successful test flights between 17 August 2016 and 17 November 2017. You’ll find a summary of these flights on The Airship Heritage Trust website here:
Airlander 10 prototype over the Hangars at Cardington Airfield.
Source: HAV

Airlander 10 prototype viewed from below.
Source: Naval Airship Association Noon Balloon, Summer 2017
Bow-on view of the Airlander 10 prototype in flight. Source: Philbobagshot via Wikipedia (7Aug2012)

On 18 November 2017, the Airlander 10 prototype broke free from it’s mooring at Cardington Airfield, triggering a safety feature that deflated the gas envelope. The airship envelope had significant damage.


In June 2018, the Airlander 10 prototype was moved from Cardington Airfield to a new HAV facility in Bedford.

The British Broadcasting Corporation (BBC) reported on 13 January 2019 that HAV had retired the Airlander 10 prototype. Since its first flight as the HAV-304 on 7 August 2012, this hybrid airship was the largest aircraft in the world.

Original prototype’s rigid gondola at the HAV facility in Bedford.  
Source: Tom Jamieson via Financial Times, 11 October 2019

Cockpit flight simulator.  
Source: Tom Jamieson via Financial Times, 11 October 2019
4. The production Airlander 10 design

The production Airlander 10 design has been refined over the past several years. The whole aerodynamic profile has been revised, with a rounder nose and a new tail section to reduce drag and improve fuel efficiency and performance. The production Airlander 10 will offer improved maintainability and lower operating costs.

![Streamlined Airlander 10 in flight with air cushion landing system retracted. Source: HAV](image)

The Airlander 10 can be configured for a variety of missions, including:

- Defense & security
- Logistics
- Luxury travel
- Maritime patrol & Coast Guard
- Corporate and private clients

The Airlander 10 will be able to accept new equipment and systems needed to transition to a future all-electric airship within the same basic airframe. HAV is working with Collins Aerospace and the University of Nottingham to transition an all-electric design by 2030.
The UK Aerospace Research and Technology Programme awarded HAV a £1 million grant for a project, named E-HAV1, to develop a prototype 500 kW (670.5 hp) electric propulsor to replace its diesel-powered forward engines. These electric propulsors will have twice the power of the 242 kW (325 hp) diesel engine-driven propulsors on the Airlander 10 prototype. The prototype electric motor built by Collins Aerospace in the UK completed its critical design review in July 2021 and is expected to be qualified for flight in 2023.

Basic design characteristics are summarized below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Production Airlander 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Semi-rigid, hybrid</td>
</tr>
<tr>
<td>Length, overall</td>
<td>320 ft (98 m) long, 5% longer than the prototype</td>
</tr>
<tr>
<td>Length, main cabin</td>
<td>151 ft (46 m) long, larger than most single-aisle commercial airliners. Main cabin is configurable and will be available in different lengths.</td>
</tr>
<tr>
<td>Width, overall</td>
<td>143 ft (43.5 m)</td>
</tr>
<tr>
<td>Height, overall</td>
<td>85 ft (26 m)</td>
</tr>
<tr>
<td>Gas envelope material</td>
<td>Vectran™, a high-performance multifilament yarn spun from liquid crystal polymer (LCP)</td>
</tr>
<tr>
<td>Gas envelope volume</td>
<td>1,342,000 ft³ (38,000 m³)</td>
</tr>
<tr>
<td>Payload</td>
<td>Up to 22,050 lb (10,000 kg)</td>
</tr>
<tr>
<td>Propulsion</td>
<td>• Base configuration: 4 x diesel engines, similar to the prototype</td>
</tr>
<tr>
<td></td>
<td>• Hybrid intermediate (circa 2025): 2 x electric motors (flank propulsors) and 2 x diesel engines (stern propulsors)</td>
</tr>
<tr>
<td></td>
<td>• All-electric (circa 2030): 4 x electric motors, zero carbon emissions</td>
</tr>
<tr>
<td>Takeoff &amp; landing distance</td>
<td>1,804 ft (550 m)</td>
</tr>
<tr>
<td>Air cushion landing system</td>
<td>Six air cushion landing “feet” extend for landing and are fully retracted in flight</td>
</tr>
<tr>
<td>Cruise speed</td>
<td>20 – 60 knots (37 - 111 kph)</td>
</tr>
<tr>
<td>Maximum altitude</td>
<td>20,000 ft (6,096 m)</td>
</tr>
<tr>
<td>Range</td>
<td>2,000 - 4,000 nautical miles (3,704 - 7,408 km) depending on mission</td>
</tr>
<tr>
<td>Maximum mission duration</td>
<td>3 days</td>
</tr>
</tbody>
</table>
In August 2020, Tom Grundy, the firm’s chief executive, announced that a GoFundMe campaign had raised £1.6 million, £630,000 more than it originally sought, to support completion of the first production Airlander 10. The company says it has letters of intent for 15 commercial airships and also is working to sell a military version.
5. Airlander 10 type certification and production schedule

Type certification of the production Airlander 10 is being done with the European Aviation Safety Agency (EASA). HAV also intends to have the Airlander 10 type certified by the US Federal Aviation Administration (FAA), with the goal of having the Type Certified airship able to operated worldwide. Key certification milestones achieved with European civil aviation authorities are:

- Design Organization Approval from EASA was received in October 2018
- Production Organization Approval from the Civil Aviation Authority (CAA) also has been received

HAV reported that, “the prototype served its purpose as the world’s first full-sized hybrid aircraft, providing us with the data we needed to move forward from prototype to production standard…… The full commercial model is expected to take to the skies with its first paying passengers in the early 2020s.”

On their Facebook page, HAV posted the following schedule for development and production of their Airlander hybrid airships. The initial production Airlander 10 will be diesel powered, with production transitioning to all-electric airships by 2030.

**Source: HAV**

After Type Certification, HAV expects that production will gradually increase to their factory capacity of 12 aircraft per year.
6. Customized Airlander 10 interior design concepts

At the July 2018 Farnborough Air Show, HAV unveiled the design of the passenger cabin for Airlander 10, which is capable of carrying up to 16 passengers with overnight accommodations on three-day, 2,000 nautical mile (3,704 km) “expeditions”.

In this section, we’ll take a look at three luxury interior design concepts that have been developed for the production Airlander 10.

**Design Q interior design concept**

The UK firm Design Q has developed an interior concept for the Airlander 10 that tailors the airship for “luxury expeditionary tourism.” The passenger accommodations are described as follows:

“Passengers on Airlander will have luxurious private en-suite bedrooms and will be able to enjoy horizon-to-horizon views in the aircraft’s extensive Infinity Lounge. The Altitude Bar will offer drinks with the ultimate view, while 18 guests can enjoy fine dining in the skies.”

“Airlander 10’s interior is unusually spacious – the (46 m long) cabin is larger than most single-aisle aircraft, such as the A320. This space allowed the team at Design Q to use their extensive experience of luxury spaces to create something full of unique features that will set new standards for excellence in air travel.”

The following Design Q graphics will give you an idea of what is possible in a “luxury expedition airship” that could be certified for commercial operations in the mid-2020s.

You can take a short video tour of the Design Q interior concept for this customized Airlander 10 here: [https://www.youtube.com/watch?v=hGTEVWIefYM](https://www.youtube.com/watch?v=hGTEVWIefYM)

You’ll find more information and the same video tour on the Design Q website here: [https://www.designq.co.uk/airlander-10](https://www.designq.co.uk/airlander-10)
Vesper Rising interior design concept

In 2017, the firm Vesper Rising announced plans to use an Airlander 10 for tourist flights in Las Vegas, NV and over the Grand Canyon. The general configuration of their planned day-tourist version of the Airlander 10, including views of the proposed interior are shown in the following graphics from the Vesper Rising website here:
https://vesperrising.com/about-us
Vesper Rising is seeking capital for this venture and likely has not placed a firm order for an Airlander 10.

Rendering of the Vesper Rising Airlander 10 configured for day tours. Source, three renderings: Vesper Rising (2017)

HAV interior design concept

In May 2021, HAV released the following renderings of a cabin interior that appears to be configured for luxury day tours.
Source, three renderings: HAV via CNN Travel (May 2021)
7. OceanSky Cruises “expedition” to the North Pole

One expedition already being offered by Swedish company OceanSky Cruises is a 38-hour luxury round-trip airship cruise to the North Pole from Svalbard Island, with lunch on the ice at the pole. They advertise this trip as, “An expedition to the North Pole without a footprint.” The airship will be outfitted with the DesignQ interior.

Source: OceanSky Cruises

Details are available on the OceanSky Cruises website here: https://www.oceanskycruises.com/north-pole-expedition/
Source, both graphics: OceanSky Cruises
8. The Airlander 50 airship

HAV is developing a larger hybrid airship known as Airlander 50. Early designs were diesel-powered, like the Airlander prototype and the initial production Airlander 10. HAV plans to certify an all-electric Airlander 50 by 2033.

*Early Airlander 50 concept drawing. Source: HAV*

*Early Airlander 50 general arrangement drawing. Source: HAV*
The central payload module has a 98 ft (30 m) internal payload bay capable of carrying up to 132,300 pounds (60,000 kg) of cargo in six 20-foot ISO containers, as shown in the following graphic. The payload module can carry up to 200 passengers in an all-passerger configuration.

![Airlander 50 central payload module design concept configured to carry six 20-foot ISO containers and 48 passengers. Source: HAV](image)

9. Beyond the Airlander 50

The basic Airlander hybrid airship design is scaled to larger sizes than the current Airlander 10 and 50 designs. HAV reports that “The future will see an Airlander 200, with the ability to fly 200 tons of freight long distances.”

10. For more information

- Vlad Savov, “Airlander 10: Up Close With the Gigantic Airship the US Army Wanted,” The Verge, 8 July 2014:
https://www.theverge.com/2014/7/8/5880061/airlander-10-photo-essay

- Henty Mance, “Boarding soon: the five-star airship bound for the North Pole,” Financial Times, 11 October 2019: https://www.ft.com/content/f34a3a56-e8fd-11e9-a240-3b065ef5fc55
• Andrea Steffen, “Airlander 10: An Airship That Produces 75% Fewer Emissions,” Intelligent Living, 4 September 2020: https://www.intelligentliving.co/airlander-10-airship/


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