ACCIDENT

Aircraft Type and Registration:	HAV Airlander 10, G-PHRG
No & Type of Engines:	4 Technify Centurion C4.0 piston engines
Year of Manufacture:	2012 (Serial no: 1)
Date & Time (UTC):	24 August 2016 at 1024 hrs
Location:	Cardington Airfield, Bedfordshire
Type of Flight:	Flight test
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to cabin flight deck area
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	12,700 hours (of which 4 were on type) Last 90 days - 3 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, event investigation report supplied by the operator/manufacturer, and further AAIB enquiries

Synopsis

At the end of a test flight the aircraft could not be secured to its mooring mast because of a fault in winching apparatus at the mast. The aircraft departed again while the issue was investigated. As it did so the mooring line, which had been secured temporarily, fell free until it hung to its full length below the aircraft. The second approach therefore had to be higher than ideal, which resulted in the aircraft arriving over the landing site at an excessive height.

The test pilot attempted to manoeuvre the aircraft in order to bring the mooring line within reach of the ground crew, but in so doing, it unexpectedly adopted an exaggerated nose-down attitude and began to descend. The pilot was unable to affect a recovery before the aircraft struck the ground, causing damage to the cabin flight deck area.

History of the flight

The aircraft was being flown on its second test flight, with the test pilot and a flight test engineer on board. The flight was supported by a ground-based flight test team and a ground handling team. The aircraft un-masted at 0812 hrs. The weather was fine, with a variable wind of about 2 kt.

Nearing the end of the test flight, 98 minutes after un-masting, the aircraft made a successful approach back to its mooring mast. The mooring line was extracted from its stowage by the ground crew for feeding onto a winch at the mooring mast assembly. However, a diesel engine that powered hydraulic pumps driving the winch could not be started, meaning that there would be a delay in securing the aircraft. Rather than loitering on the ground for a prolonged period, the pilot decided to take the aircraft airborne again. The mooring line was temporarily stowed through a small access panel in the cabin door but, after the aircraft left the ground, the rope fell out under its own weight until its full length was hanging free.

The pilot liaised with the ground team to establish the length of mooring line below the aircraft, but was incorrectly informed that it was about 50 ft (it was actually 47 m / 155 ft long). Once the problem with the ground equipment had been resolved, the pilot flew a further approach, although it had to be steeper to ensure the mooring line did not become entangled in trees or on the perimeter fence. Despite this precaution, at a height of about 120 ft on the approach, the line became entangled in wires which crossed the approach path about 200 m outside the airfield boundary.

Although the line was freed from the wires, the encounter contributed to a high final approach. Consequently a descent to ground level was not possible in the landing distance available and the aircraft arrived over the landing area at about 180 ft. The aircraft was reluctant to descend naturally and, with no forward airspeed, the pilot had limited control. He attempted to trim the aircraft nose-down by management of the centre of gravity, so that the mooring line would come within reach of the ground crew but, with the aircraft at about 10º nose-down pitch angle, it suddenly pitched further down to about 18º and started to descend.

The pilot attempted to arrest the descent with the control available and was partly successful in that the aircraft's nose-down attitude started to reduce. However, there was insufficient height in which to affect a full recovery and the aircraft struck the ground still in an excessive nose-down attitude, causing structural damage to the flight deck area. The accident occurred 2 hours 12 minutes after un-masting.

Although the aircraft's systems appeared to remain fully functional after the impact, the crew was exposed to the open air through the damaged cabin sides, so the decision was made to evacuate. The aircraft's systems were secured and the pilot and engineer vacated to the left and right, through gaps in the damaged structure. There were no injuries to flight or ground crew, and the aircraft was subsequently attached to the mooring mast and secured.

Aircraft information

General

The Airlander 10 (Figure 1) is a development of the HAV 304 hybrid aircraft which was designed and produced as a long-endurance surveillance platform for the US military. The hull is a large pressure-stabilised fabric structure containing helium and air in separate compartments. Its aerodynamic shape contributes up to 40% of the vehicle's total lift. The Airlander 10 made its first test flight on 17 August 2016.

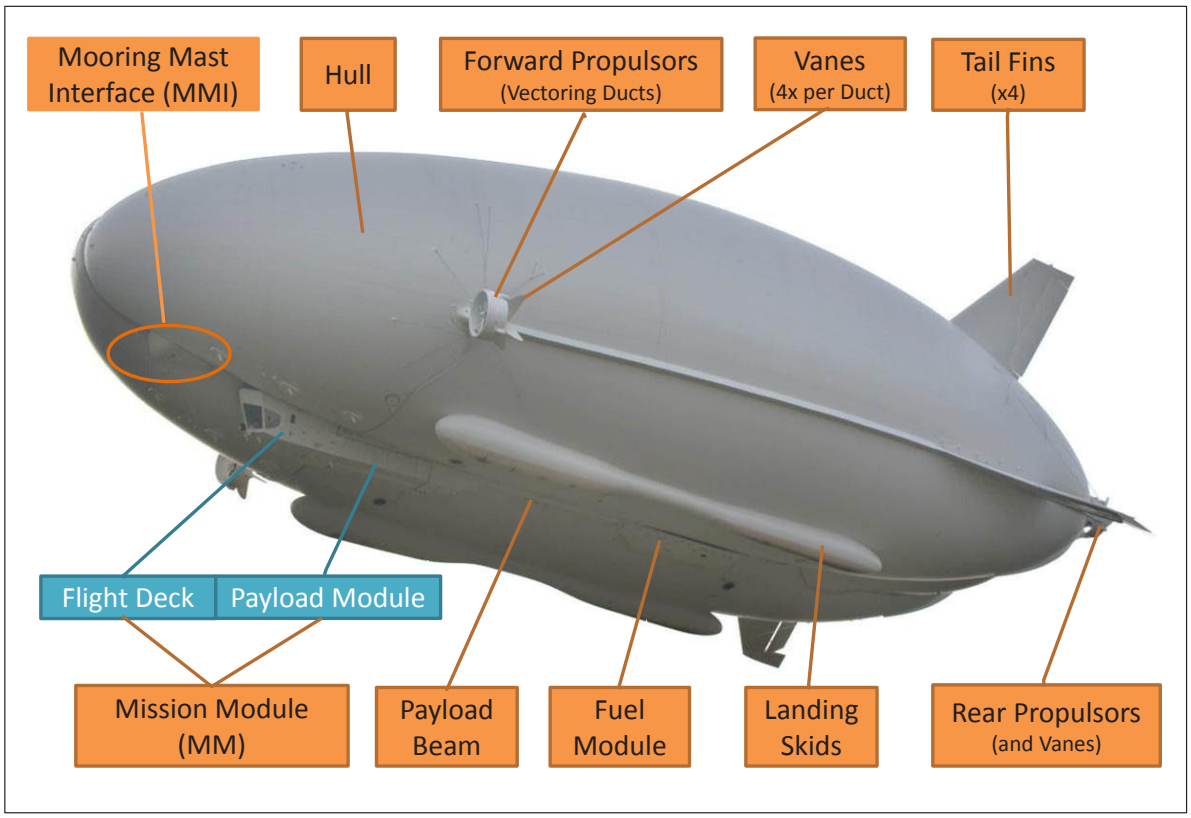

Figure 1

Main assemblies of the Airlander 10 (*Courtesy Ivor Pope / HAV)*

The 92 m long aircraft is powered by four turbocharged diesel engines, two mounted forward and two at the stern. The engines are configured to provide an element of vectored thrust for takeoff, landing and ground handling operations.

The flight deck is mounted at the forward end of the mission module, a structure suspended under the centreline of the hull.

The buoyancy of the aircraft is expressed in terms of static heaviness. A static heaviness of zero would equate to neutral buoyancy, such that the aircraft would neither rise nor fall unless acted on by other forces. In normal operation the aircraft has positive static heaviness, being overall heavier than air. Generally, static heaviness reduces as fuel is burned and it may also be affected by precipitation and by environmental warming of the helium gas.

Landing and mooring procedures

The intended normal landing profile involves a touchdown with some forward airspeed, followed by a short landing roll as the aircraft naturally slows to a stop. Without the means of providing significant vertical thrust, the aircraft is not capable of true vertical landings (in calm or very light wind conditions).

The aircraft's mooring line is normally attached to, and stowed within, the Mast Mooring Interface (MMI), a structure forward of the flight deck. In the stowed configuration, the free end of the line is attached to the aircraft at a point just below the flight deck windscreens. The mooring procedure involves a ground crew member detaching the free end of the line and pulling the line out of the MMI. The free end is then fed onto a winch at the mooring mast so that the aircraft can be winched onto the mast and secured.

Operator's investigation findings

An investigation was carried out by the aircraft manufacturer/operator. In summary, the investigation determined that the higher than planned approach had been necessary in order to allow sufficient clearance for the mooring line. In turn, the mooring line had come to be hanging free below the aircraft because there was no proper stowage facility for the mooring line once it has been extracted from the MMI. The high approach led to a situation that was considered outside the aircraft's normal operating regime, in that it required a controlled vertical landing in very light wind conditions. The static heaviness of the aircraft had probably reduced as a result of additional environmental heating occurring between the first and second approaches.

The investigation determined that an electrical fault had caused the winch diesel engine's starter battery to drain. The engine could not therefore be started, which rendered the winch inoperative.

The investigation made a number of recommendations intended to minimise the chance of reoccurrence, as well as a number of observations on matters peripheral to the accident. These included the need for effective stowage and control arrangements for a deployed mooring line, enhanced maintenance and fault reporting regimes for ground support equipment, and a review of relevant static heaviness issues.