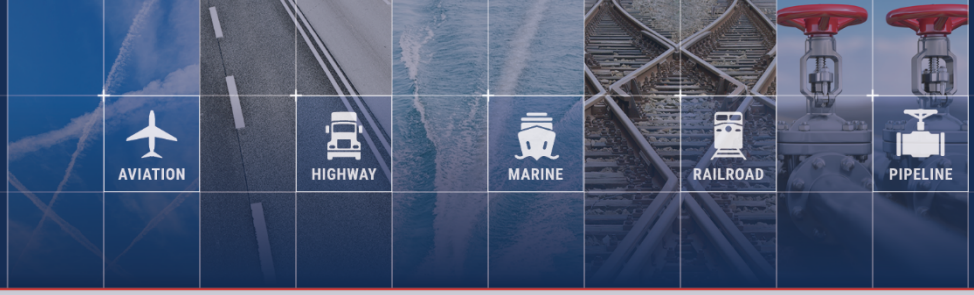

Aviation Investigation Final Report

Location:	Manassas, Virginia	**Accident Number:**	DCA19LA154
Date & Time:	June 4, 2019, 07:19 Local	**Registration:**	N83AU
Aircraft:	Aurora PAV	**Aircraft Damage:**	Substantial
Defining Event:	Flight control sys malf/fail	**Injuries:**	N/A
Flight Conducted Under:	Part 91: General aviation - Flight test		

Analysis

The aircraft experienced a vibrational excitation environment which exceeded the previously measured accelerations used to establish an autopilot ground-sensing threshold. The excessive oscillations activated the ground-sensing system, which transitioned the autopilot from Autoland into "ground" mode and commanded a reduction in rotor speed.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: a loss of hover lift thrust provided by the eight lift motors due to a false on-ground rotor speed reduction command, resulting from excessive vibration.

Findings

Aircraft	(general) - Malfunction

Factual Information

History of Flight

Uncontrolled descent	Flight control sys malf/fail (Defining event)

HISTORY OF FLIGHT

On June 4, 2019, at 0709 eastern daylight time (EDT), an Aurora Flight Sciences Pegasus Passenger Air Vehicle (PAV) unmanned aircraft system, N83AU, crashed during landing on runway 34L at the Manassas Regional Airport, Manassas, VA. There were no injuries, and the aircraft was substantially damaged. The aircraft was operated as a developmental test flight under the provisions of 14 CFR part 91 and an FAA Certificate of Waiver or Authorization (COA).

The aircraft was positioned on runway 34L for a vertical takeoff and landing, along with low speed maneuvering test. The aircraft took off normally and the pilot, who controlled the aircraft from a ground station in a building on the east side of the airport, entered pre-planned flight test stability check maneuvers, including brief lateral maneuvers followed by forward translations along the runway centerline in accordance with the test plan. The flight test engineers noted some brief data dropouts and abnormal motor speeds, and the team decided to terminate the flight. The pilot entered the autoland command, and the aircraft initially responded. After a small descent, the aircraft motors went to idle and the aircraft descended vertically at a high rate and impacted the runway, breaking the aft booms, the horizontal stabilizer, and other significant structure. The #3 motor exhibited a brief flash of fire or sparking on impact.

The aircraft remained with the planned test area.

INJURIES TO PERSONS

None.

DAMAGE TO AIRCRAFT

There was structural damage to the booms, horizontal tail, vertical tails, and warping of the main aircraft structure. The aft section of the booms, with the two aft-most lift motors, were fractured.

PERSONNEL INFORMATION

The pilot, age 46, was an FAA certified commercial pilot airplane and helicopter, and reported 3,500 hours total time.

The aircraft was also supported by a visual observer stationed nearby the runway, and a team of flight test engineers in the control station located in a building on the east side of the airport.

AIRCRAFT INFORMATION

The PAV is a developmental unmanned aircraft intended for Urban Air Mobility applications. The aircraft consists of a center fuselage which contains two (simulated) occupants, the main power battery, avionics and flight control computers, and an essential bus flight control battery. At the aft of the fuselage is an electric motor with pusher propeller for fixed-wing mode flight (this motor was disabled during the accident flight).The aircraft has a forward canard, main wing, and an aft mounted horizontal stabilizer with dual vertical stabilizers. A boom runs along each side containing 8 total vertical takeoff/landing (VTOL) electric motors.

The aircraft was controlled from a ground control station located at the Manassas Airport, and linked to the aircraft via a 2.4gHz connection with two radio nodes.

The normal landing maneuver for the PAV was an autoland, which establishes a vertical descent and transitions to on-ground mode using a combination of squat switches and a time derivative of acceleration known as "jerk" logic. When the aircraft contacts the ground and either the squat switches close or an acceleration spike is detected, the logic switches to ground mode and commands the VTOL motors to idle. The aircraft was equipped with a radar altimeter, but in this test configuration it was not used for ground detection in the autoland sequence.

METEOROLOGICAL INFORMATION

Weather was clear with calm wind.

COMMUNICATIONS

There were no communications difficulties with the accident flight.

AERODROME INFORMATION

The Manassas Regional Airport/Harry P. Davis Field (HEF), was located about 3 miles southwest of Manassas, Virginia, at an elevation of 192 feet mean sea level (msl). The airport has an FAA Air Traffic Control Tower which operates from 0630-2230 local time daily. The airport has two parallel runways 16L/34R, and 16R/34L (the accident runway). Runway 16R/34L had an asphalt surface 3,175 feet long and 100 feet wide. There were no reported abnormalities with the airport or facilities.

RECORDED DATA

A review of the recorded data was provided by the operator/manufacturer revealed that airframe vibration occurred in a resonant mode and was transmitted through the structure into the flight controller. The accelerations resulting from the vibrations briefly exceeded the jerk logic threshold and the aircraft entered the ground mode, subsequently commanding the motors to shutdown.

Information

Certificate:	**Age:**
Airplane Rating(s):	**Seat Occupied:**
Other Aircraft Rating(s):	**Restraint Used:**
Instrument Rating(s):	**Second Pilot Present:**
Instructor Rating(s):	**Toxicology Performed:**
Medical Certification:	**Last FAA Medical Exam:**
Occupational Pilot:	**Last Flight Review or Equivalent:**
Flight Time:	

Aircraft and Owner/Operator Information

Aircraft Make:	Aurora	**Registration:**	N83AU
Model/Series:	PAV	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	1
Landing Gear Type:	Skid	**Seats:**	0
Date/Type of Last Inspection:		**Certified Max Gross Wt.:**	900 lbs
Time Since Last Inspection:		**Engines:**	Electric
Airframe Total Time:		**Engine Manufacturer:**	Magicall
ELT:		**Engine Model/Series:**	
Registered Owner:	Aurora Flight Sciences	**Rated Power:**	
Operator:	Aurora Flight Sciences	**Operating Certificate(s) Held:**	Certificate of authorization or waiver (COA)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KHEF,200 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	10:56 Local	**Direction from Accident Site:**	0°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.19 inches Hg	**Temperature/Dew Point:**	8°C / 7°C
Precipitation and Obscuration:			
Departure Point:	Manassas, VA (KHEF)	**Type of Flight Plan Filed:**	None
Destination:	Manassas, VA (KHEF)	**Type of Clearance:**	None
Departure Time:	07:01 Local	**Type of Airspace:**	Class D

Airport Information

Airport:	Manassas KHEF	**Runway Surface Type:**	Asphalt
Airport Elevation:	200 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	34L	**IFR Approach:**	None
Runway Length/Width:	3500 ft / 100 ft	**VFR Approach/Landing:**	Precautionary landing

Wreckage and Impact Information

Crew Injuries:	N/A	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	N/A	**Latitude, Longitude:**	38.721942,-77.517776

Administrative Information

Investigator In Charge (IIC):	English, William
Additional Participating Persons:	
Original Publish Date:	March 13, 2020
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=99537

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person" (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available here.