Aviation Investigation Final Report

Location:	Yuma, Arizona	**Accident Number:**	DCA16CA197
Date & Time:	June 28, 2016, 07:43 Local	**Registration:**	N565AQ
Aircraft:	FACEBOOK UK LTD AQUILA	**Aircraft Damage:**	Substantial
Defining Event:	Aircraft structural failure	**Injuries:**	N/A
Flight Conducted Under:	Part 91: General aviation - Flight test		

Analysis

On June 28, 2016, at 0743 mountain standard time, the Facebook Aquila unmanned aircraft, N565AQ, experienced an inflight structural failure on final approach near Yuma, Arizona. The aircraft was substantially damaged. There were no injuries and no ground damage. The flight was conducted under 14 Code of Federal Regulations Part 91 as a test flight, the aircraft did not hold an FAA certificate of airworthiness.

This was the first flight of the full-scale aircraft. The flight launched in restricted airspace from Yuma Proving Ground's (YPG) Site 8 UAV runway. There were no anomalies noted during the 90-minute flight.

According to the operator, at 0704, a simulated landing at 1,250 feet above sea level was performed to test the autoland feature of the autopilot. Autoland is the normal, and only, landing maneuver of the aircraft. The maneuver was executed normally, tracking the centerline and glidepath, and obeying the wave-off command. At the time of the simulated landing, the crew noted that the wind had increased above the intended test limit of 7 knots at flight altitude.

At 0737, the crew commanded a landing to the designated landing site. During the final approach, the aircraft encountered an increasing amount of turbulence and wind speeds of up to 10 knots at the surface and 12 to 18 knots, as measured by the aircraft at flight altitude. The operators post-flight telemetry analysis showed that the aircraft experienced significant deviations in pitch, roll, and airspeed, consistent with turbulence during the final approach.

At 0743, while on final approach at 20 feet above the ground, the right outboard wing experienced a structural failure with a downward deflection. Four seconds later, the aircraft impacted the ground at a groundspeed of 25 knots in an approximately wings-level attitude. The aircraft sustained substantial damage as a result of the impact and wing failure. As a result of the aircrafts design (skid landing gear, low-slung engines and propellers), the operator expected some damage during normal landings.

The operators analysis of available data indicates that the structural failure was likely initiated by a wind gust that lofted the aircraft above the glidepath about 5 seconds prior to failure. The autopilot responded to this gust by lowering the nose of the aircraft to reestablish itself on the glidepath. The airspeed then increased to 28 KIAS from the normal 24 KIAS. As the aircraft descended back onto the glidepath, the autopilot started to deflect the elevons upwards.

The operator determined that the combination of high airspeed, up elevon, and low angle of attack, resulted in increased downward lift (and torsion) on the outer wing panels. This loading exceeded its structural limit and resulted in a downward deformation and failure of the right wing. At the time of the last gust (5 seconds prior to touchdown) the aircraft was near idle power and the inboard propellers were commanded to the windmilling state - the highest drag configuration available to the autopilot.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

a structural failure of the wing as a result of exceeding the airspeed envelope due to wind gusts which were beyond the capabilities of the autopilot. Contributing to the accident was an insufficient amount of drag to track the glideslope in the presence of atmospheric disturbances.

Findings

Aircraft	Main frame (on wing) - Failure
Environmental issues	Convective turbulence - Effect on equipment
Aircraft	Autopilot computer - Capability exceeded

Factual Information

History of Flight

Approach	Aircraft structural failure (Defining event)
Approach	Turbulence encounter

Pilot Information

Certificate:	Private	**Age:**	29
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	July 28, 2015
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	April 4, 2015
Flight Time:	1688 hours (Total, all aircraft), 2 hours (Total, this make and model), 1609 hours (Pilot In Command, all aircraft), 13 hours (Last 90 days, all aircraft), 2 hours (Last 30 days, all aircraft)		

Co-pilot Information

Certificate:	Private	**Age:**	37
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	March 16, 2016
Occupational Pilot:		**Last Flight Review or Equivalent:**	March 15, 2016
Flight Time:	2263 hours (Total, all aircraft), 28 hours (Total, this make and model), 624 hours (Pilot In Command, all aircraft), 17 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	FACEBOOK UK LTD	**Registration:**	N565AQ
Model/Series:	AQUILA 1A	**Aircraft Category:**	Airplane
Year of Manufacture:	2015	**Amateur Built:**	
Airworthiness Certificate:	None	**Serial Number:**	F1501
Landing Gear Type:	Skid	**Seats:**	0
Date/Type of Last Inspection:	June 27, 2016	**Certified Max Gross Wt.:**	937 lbs
Time Since Last Inspection:		**Engines:**	4 Electric
Airframe Total Time:	1.5 Hrs at time of accident	**Engine Manufacturer:**	Joby Motor
ELT:	Not installed	**Engine Model/Series:**	
Registered Owner:	FCL Tech	**Rated Power:**	
Operator:	Facebook, Inc.	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	N/A	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	07:27 Local	**Direction from Accident Site:**	360°
Lowest Cloud Condition:	Clear	**Visibility**	
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots /	**Turbulence Type Forecast/Actual:**	/ Convective
Wind Direction:	180°	**Turbulence Severity Forecast/Actual:**	/ Moderate
Altimeter Setting:	29.79 inches Hg	**Temperature/Dew Point:**	33°C
Precipitation and Obscuration:			
Departure Point:	Yuma, AZ (N/A)	**Type of Flight Plan Filed:**	None
Destination:	Yuma, AZ (None)	**Type of Clearance:**	None
Departure Time:	06:07 Local	**Type of Airspace:**	Restricted area

Airport Information

Airport:	Site 8 YPG None	**Runway Surface Type:**	Gravel
Airport Elevation:	680 ft msl	**Runway Surface Condition:**	Dry;Soft
Runway Used:	8	**IFR Approach:**	None
Runway Length/Width:	500 ft / 500 ft	**VFR Approach/Landing:**	Full stop;Straight-in

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:**	33.099998,-114.400001

Administrative Information

Investigator In Charge (IIC):	English, William
Additional Participating Persons:	
Original Publish Date:	December 16, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	This accident report documents the factual circumstances of this accident as described to the NTSB.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=93514