Aviation Investigation Final Report

Location:	KEYMAR, Maryland	**Accident Number:**	NYC00LA134
Date & Time:	May 13, 2000, 17:10 Local	**Registration:**	N2685
Aircraft:	Hing FLY BABY 1A	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

According to witnesses, the homebuilt Fly Baby was cruising about 1,500 feet above the ground, in a climb or nose high attitude. The witnesses reported hearing a popping sound, after which the right wing folded up next to the fuselage. The airplane descended, and struck the ground. Examination revealed the two flying wires on the underside of the forward right wing spar were separated from the wing. One wire had failed at its loop through the eye of the turnbuckle, and the other wire separated at a failed turnbuckle. Metallurgical examination found evidence of overload on both failures. According to the designer of the airplane, the airplane had been static load tested to 6gs with no failure. In addition, each pair of flying wires must have similar or matched tension. If one wire was loose, a momentary flight load could exceed the load capability of one wire, which would cause it to fail, followed by the failure of the second wire as it tried to assume the load. The pre-accident tension on the failed flying wires could not be determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: An overload failure of both flying wires, on the underside of the right wing, while the airplane was climbing, due to improper balance between the two flying wires, by unknown person(s).

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: CLIMB

Findings
1. (C) WING,BRACING WIRE - OVERLOAD
2. (C) MAINTENANCE,BALANCING - IMPROPER - UNKNOWN

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Factual Information

HISTORY OF FLIGHT

On May 13, 2000, about 1710 Eastern Daylight Time, a homebuilt Fly Baby 1A, N2685, was destroyed when it struck the ground near Keymar Airpark Airport, Keymar, Maryland. The certificated private pilot was fatally injured. Visual meteorological conditions prevailed for the personal flight. No flight plan had been filed for the flight that had departed from Fairfield, Pennsylvania, and was conducted under 14 CFR Part 91.

According to an inspector from the Federal Aviation Administration (FAA), and witnesses, the airplane was observed to over-fly the airport, parallel to the runway, in a southwesterly direction, about 1,500 feet above ground level (AGL). One witness thought the airplane was in a climb, while the other witness reported the airplane was in a nose high attitude. The witnesses reported hearing a "bang" or "popping sound", and observed the right wing fold up against the side of the fuselage. The airplane then descended and struck the ground in an open field about 1/4 miles southeast of the airport.

PERSONNEL INFORMATION

The pilot held a private pilot certificate for single engine airplanes and glider aero-tow. He was last issued a FAA third class airman medical certificate on November 11, 1999. According to his last medical certificate application, he had a total flight experience of 300 hours. The pilot's flying logbook was not recovered, and the pilot's total flight experience, recency of experience, and last flight review were not determined.

AIRCRAFT INFORMATION

The airplane was issued an amateur built, experimental airworthiness certificate. The design was an open cockpit, with conventional landing gear, and a low wing. The design of the wing allowed them to be folded against the fuselage for storage in reduced space. For flight, the wings were held in place with landing wires on the top of the wings, and flying wires on the bottom of the wings. Wires were attached to both the top and bottom of the forward and rear spars. The wires on the top of the wing terminated at the fuselage, forward of the cockpit. The wires on the bottom of the wing terminated at the outside of the main landing gear wheels. Two wires were located at each attach point.

According to the owner of the airplane, he had bought the airplane about 3 or 4 months before the accident and planned to use it for parts. When the accident pilot became interested in flying the airplane, the owner told the accident pilot that prior to flying it, a mechanic needed to conduct an annual inspection on the airplane. The owner did not believe the accident pilot had

complied with his request to have the airplane inspected prior to flight. The owner had no knowledge of either the annual inspection or any other maintenance being performed on the airplane. In addition, he reported that he did not know the whereabouts of the airplane maintenance records, and was unaware of who had last rigged the airplane.

WRECKAGE AND IMPACT INFORMATION

The airplane was examined at the accident site on May 13, 2000. The FAA inspector reported that the airplane had impacted in a nose down attitude. The right wing was displaced from its normal position, and was next to the fuselage. The two flying wires on the underside of the front spar on the right wing were separated from the wing. One wire had failed in the loop through an eye, and the other wire was separated from the wing due to a failed turnbuckle.

The pre-failure tension of the two failed wires could not be determined.

Both wing tips and the tail surfaces were accounted for at the accident site. Flight control continuity was confirmed with no evidence of a failed flight control cable.

MEDICAL AND PATHOLOGICAL INFORMATION

The toxicological testing report from the FAA Toxicology Accident Research Laboratory, Oklahoma City, Oklahoma, was negative for drugs and alcohol for the pilot.

The Medical Examiners Office, State of Maryland, conducted an autopsy on the pilot on May 14, 2000.

TESTS AND RESEARCH

The failed wires from the right wing were forwarded to the Safety Board Materials Laboratory for examination. According to the materials specialists factual report:

"...[The turnbuckle] 'necking' is a typical feature found when a ductile material separates due to overstress...Hardness measurements, taken on the threaded end of the terminal, showed an average bulk hardness of 28 HRC...The wire rope separated through the loop...The fractures on the individual wires were all orientated along one or more 45 degree planes, consistent with overstress separations. Scanning electron microscope examination of the wire fractures revealed elongated ductile dimples on the surface...."

Additional examinations were conducted on the failed components at a later date. According to the follow-on report from the specialists:

"...Examination of the inner surface of the individual wires [wire rope] revealed no indications of flattening to any wire adjacent to the fractures. The examination did reveal light fretting marks on inner surface of three individual wires...."

The wear pattern on the eye end of the turnbuckle where a thimble had been used was compared to the wear pattern on the eye end of the turnbuckle where the fail wire had been installed. The report stated, "...The wear patterns on the two eye ends were very similar in appearance. No evidence of the impressions of individual wires were noted on the eye ends...."

Further, the report stated:

"...The previous report indicated that the hardness on the threaded end of the eye end was 28 HRC. Examination of documents received after the previous report was issued indicates that the eye end was style AN-170 and that the hardness should be between 27 and 32 HRC...."

The wire rope was subjected to a pull test to determine its strength. The report stated:

"...In the first test the cable failed at a load of 2,063 pounds. Unfortunately the cable test fixture rollers rotated putting the cable in partial shear and failing its prematurely. In the second test the cable was gripped in aluminum sleeves and failed at a load of 2,165 pounds. Reportedly the cable was rated for a load of 2,200 pounds...."

ADDITIONAL INFORMATION

The designer of the airplane reported that the strength of the wing structure was obtained from the flying and landing wires. This type of design reduced the drag, and held the weight increase to the addition of the wires. In steady flight, the forward flying wires were carrying about 60 percent of the load, and the aft flying wires about 40 percent of the load. Due to individual differences in construction, this could vary from airplane to airplane. The center of lift would shift across the top of the wing with changes in angle of attack. At higher angles of attack such as a climb, the center of lift would shift forward and increase the load on the forward flying wires. The amount of change in loads between the forward and aft flying wires would normally be about 5 percent. Adjusting the tension on the flying and landing wires would set the dihedral of the wings. A master turnbuckle on the upper fuselage was used to adjust the landing wires, which in turn put tension on the flying wires.

Although he designed the airplane with two flying wires at each attach point, he had conducted a flight test with just one wire attached at each attach point. The second wire was a safety item; to increase the load the wings were capable of holding. Further, a completed Fly Baby, which was properly rigged, was static load tested to 6gs with no failure.

The designer also reported that the most important thing about flying wires was to keep the load balanced with each set of two flying wires carrying the same or nearly the same load. When the load was not balanced between the wires, and an increased flight load was generated, the total load would be picked up by one wire. If the total load exceeded the capability of the wire, it would fail, followed by failure of the second wire as it momentarily tried

to assume the same load, after failure of the first wire. The most important thing with paired flying wires was to ensure that the load was split evenly between each pair of flying wires.

The designer also reported the wings could be folded, by first reducing the tension on the master turnbuckle located forward of the cockpit near the top of the fuselage. This reduced the tension on the upper landing wires, which in turn reduced the tension on the lower flying wires. Once the tension was reduced, the spar pin could be removed and the wing folded with leading edge down. The wings could then be rotated back against the fuselage. To reset the wings for flight, they would first have to be extended, and then rotated to level, after which the spar pins were inserted. The master turnbuckle would then be used to tension all landing and flying wires simultaneously. It was not necessary to retension each individual flying and landing wire, each time the wings were folded and reset for flight.

According to FAA Advisory Circular 20-27D, Certification and Inspection of Amateur-Built Aircraft, Section 5 FAA Inspection Criteria:

"...The amateur-built program was designed to permit person(s) to build an aircraft solely for educational or recreational purposes. The FAA has always permitted amateur builders freedom to select their own designs. The FAA does not formally approve these designs since it is not practicable to develop design standards for the multitude of unique design configurations generated by kit manufacturers and amateur builders....

"...Since 1983, FAA inspections of amateur-built aircraft have been limited to ensuring the use of acceptable workmanship methods, techniques, practices, and issuing operating limitations necessary to protect persons and property not involved in this activity...."

Following the examination of the airplane, the FAA inspector departed the scene. There was no one available to release the wreckage to.

Pilot Information

Certificate:	Private	**Age:**	53,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Center
Other Aircraft Rating(s):	Glider	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	November 11, 1999
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	
Flight Time:	300 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Hing	**Registration:**	N2685
Model/Series:	FLY BABY 1A FLY BABY 1	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	2572
Landing Gear Type:	Tailwheel	**Seats:**	1
Date/Type of Last Inspection:	Unknown	**Certified Max Gross Wt.:**	925 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:		**Engine Manufacturer:**	Continental
ELT:	Not installed	**Engine Model/Series:**	A-75
Registered Owner:	RICHARD D. HORIGAN	**Rated Power:**	75 Horsepower
Operator:	JAMES N. JONES	**Operating Certificate(s) Held:**	None
Operator Does Business As:		**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	HGR ,704 ft msl	**Distance from Accident Site:**	25 Nautical Miles
Observation Time:	16:53 Local	**Direction from Accident Site:**	295°
Lowest Cloud Condition:	Unknown	**Visibility**	8 miles
Lowest Ceiling:	Broken / 8000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	250°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	29°C / 22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	FAIRFIELD , PA (W73)	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	00:00 Local	**Type of Airspace:**	Class E

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	39.590793,-77.259437(est)

Administrative Information

Investigator In Charge (IIC):	Hancock, Robert
Additional Participating Persons:	RAYMOND G STINCHCOMB; BALTIMORE , MD
Original Publish Date:	July 17, 2001
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=49179