



National Transportation Safety Board Aviation Accident Final Report

Location:	Fort Pierce, FL	Accident Number:	ERA15FA175
Date & Time:	04/01/2015, 1100 EDT	Registration:	N224BD
Aircraft:	BEDECORP LLC BD-22	Aircraft Damage:	Destroyed
Defining Event:	Abrupt maneuver	Injuries:	1 Fatal
Flight Conducted Under:	Part 91: General Aviation - Flight Test		

Analysis

The commercial pilot was tasked with performing high-speed taxi tests and familiarization with the experimental airplane. After performing two high-speed taxis, the pilot requested taxi clearance to the active runway, received a takeoff clearance, and departed from the runway. Witnesses reported that, after departure and while in the traffic pattern, the airplane's pitch oscillated and that, when it turned onto the final leg of the traffic pattern, it continued to pitch up and down. The airplane subsequently descended and impacted terrain about 1 mile from the approach end of the runway.

Images captured by an onboard video recorder provided information about where the pilot's attention was directed, his interaction with the flight controls, and the status of cockpit instruments and engine indicators. The information indicated that the pilot did not pin his left arm to the armrest and that he used his entire forearm to move the airplane's sidestick flight control. In addition, the pilot released and re-gripped the sidestick several times, which exacerbated the negative g maneuvers. These control inputs were indicative of the pilot overcontrolling the airplane. As the pilot flew the right-hand traffic pattern, he repeatedly turned his head right and/or reached right. These movements and distractions resulted in the airplane beginning to oscillate. In each of the pitch excursions, except for one that occurred during the takeoff, the pilot's left arm moved fore and aft, and negative gs were present. During the flight, as the speed increased, each pitch oscillation increased; the final adjustment of the flight control by the pilot resulted in an overstress of the airframe and its subsequent in-flight breakup.

A postaccident examination of the airframe, flight controls, and engine revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation. Although the pilot reported a high level of total flight experience, he had accumulated less than 1/2 hour of total flight experience in the accident airplane make and model at the time of the accident. The airplane manufacturer's flight test policy indicated that, to gain experience, pilots should first taxi the airplane, then perform high-speed taxis, then perform high-speed taxis with the nose gear off the ground, and finally, after the pilot was comfortable with the airplane, to perform a takeoff. The pilot decided to perform the takeoff without the requisite experience; therefore, he

was operating contrary to the manufacturer's flight test policy.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's excessive pitch control inputs to the airplane's sidestick control, which resulted in an overstress of the airframe and its subsequent in-flight breakup. Contributing to the accident was the pilot's decision to operate the airplane contrary to the manufacturer's flight test policy.

Findings

Aircraft	Dynamic load - Capability exceeded (Cause)
Personnel issues	Aircraft control - Pilot (Cause) Decision making/judgment - Pilot (Factor)

Factual Information

HISTORY OF FLIGHT

On April 1, 2015, about 1100 eastern daylight time, an experimental Bedecorp BD-22, N224BD, was destroyed when it impacted terrain while attempting to land at St. Lucie County International Airport (FPR), Fort Pierce, Florida. The airplane was owned and operated by Bedecorp, LLC. The commercial pilot was fatally injured. Visual meteorological conditions prevailed and no flight plan was filed for the local test flight. The flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91 and originated at 1046 from FPR.

According to air traffic control data provided by the Federal Aviation Administration (FAA), the pilot completed a total of two high speed taxi operations on runway 32 at FPR and then taxied to the ramp. One of the high speed taxis was recorded by an on-board video camera. Approximately 30 minutes later, the pilot requested taxi clearance to the active runway, received a take-off clearance, and departed runway 28L. After turning onto the downwind leg of the traffic pattern, the airplane overtook another airplane. The tower controller attempted to contact the pilot three times while the airplane was on the downwind leg of the traffic pattern and never received a response. Then, the pilot reported that the airplane was on the left base leg of the traffic pattern turning onto the final leg of the traffic pattern. The tower controller communicated that the pilot had not answered his calls and he was cleared to land on Runway 28L. The pilot read-back the landing clearance and the tower controller advised the pilot to call the tower after landing. The pilot responded that he "had a little unusual stuff" during the flight and apologized. Soon after, another pilot in the traffic pattern observed the accident airplane impact the ground.

The airplane manufacturer stated that the airplane was in the first stage of flight testing and the pilot was to only perform high speed taxi maneuvers so that he could become familiar with the airplane.

According to eyewitnesses, the airplane performed two taxi tests. Then, the airplane departed runway 28L, appeared to have "issues" because its pitch oscillated while in the traffic pattern. When the airplane turned on to the final leg of the traffic pattern, it continued to pitch up and down. Subsequently, the airplane descended and impacted terrain approximately one mile from the approach end of runway 28L.

PERSONNEL INFORMATION

According to FAA records, the pilot held a commercial pilot certificate with ratings for airplane multiengine land, single-engine land, single-engine sea, instrument airplane, and a flight instructor certificate with a rating for airplane single-engine. The pilot reported, on his most recent second-class medical certificate application, dated December 11, 2013, a total flight experience of 4,500 flight hours and 50 hours in preceding six months. Furthermore, according to video evidence, the pilot had approximately 0.4 hours of experience in the accident airplane make and model, of which, 0.3 hours was taxiing. The pilot was employed by the operator as a test pilot, and the accident flight was the pilot's first in the airplane make and model.

AIRPLANE INFORMATION

According to FAA records, the airplane was issued a special airworthiness certificate on

February 11, 2015, and registered to Bedecorp, LLC. It was equipped with a Lycoming O-235-L2C, 115-hp engine. At the time of the accident the airplane had accumulated about one hour of total time in service.

According to the manufacturer, the airplane was a prototype, and the flight testing had recently begun. In addition, during the previous flight, another test pilot had mentioned that the flight control "was too heavy" and it was not sensitive enough. Subsequently, the stabilator trim tab connecting rod ends were adjusted from the original position in order to provide more control authority. The airplane utilized a side-stick flight control, similar to other Bedecorp designed airplanes.

METEOROLOGICAL INFORMATION

The 1053 recorded weather observation at FPR included wind from 280 at 8 knots, visibility 10 miles, clear skies, temperature 22 degrees C, dew point 16 degrees C, and barometric altimeter of 30.18 inches of mercury.

AIRPORT INFORMATION

St. Lucie County International Airport was located 3 miles northwest of Fort Pierce, Florida. It had three runways designated 10R/28L, 14/32, and 10L/28R. The runway designated as 10R/28L was 6,492 feet-long and 150 feet-wide, constructed of asphalt and noted in "good condition." At the time of the accident the airport had an operating air traffic control tower.

WRECKAGE AND IMPACT INFORMATION

The airplane impacted terrain in a nose down attitude and came to rest inverted, on a 092 degree magnetic heading. There was an impact crater approximately 18 inches deep. The on-board camera, canopy, and seats separated from the airframe.

The leading edge of the right wing exhibited impact crush damage along the entire span of the wing. The wing tip was separated but located in the vicinity of the right wing. The right aileron was separated and located approximately 12 feet aft of the right wing. The inboard 6-foot forward section of the right wing was consumed by post impact fire. The inboard right wing flap remained attached to the right wing and the outboard section was impact separated.

The empennage remained attached to the fuselage. The right stabilator remained attached to the empennage and was bent in the positive direction. The right stabilator tip remained attached to the stabilator. The right stabilator exhibited crush damage on the outboard leading edge. The left stabilator was separated from the empennage and located about one foot aft of the main wreckage. The left stabilator tip remained attached at all attach points. The rudder remained attached to the vertical stabilizer at all attach points and exhibited crush damage at the top section of the rudder. The vertical stabilizer remained attached to the empennage and exhibited crush damage on the approximate top 12 inches of the vertical stabilizer.

The inboard 6 foot section of the left wing was consumed by post impact fire. The entire span of the left wing leading edge exhibited crush damage. The left flap remained attached to the wing. The left aileron remained attached to the wing at all attach points. The left wing tip was separated and located in the vicinity of the main wreckage.

The fuselage remained intact and the cabin area was consumed by post impact fire. The main landing gear remained attached to the fuselage and exhibited fire damage. The nose landing gear was separated from the fuselage and located approximately 6 feet forward of the main

wreckage. Flight control continuity was confirmed from the ailerons, rudder, and stabilators to the respective flight controls. There were no malfunctions or abnormalities of the airplane noted that would have precluded normal operation prior to the accident.

The engine was located in the initial impact crater and remained attached to the fuselage through engine control cables. The oil pan, carburetor, oil filter, and a section of the engine driven fuel pump were impact separated from the engine and located in the initial impact crater. Cylinders Nos. 1 and 2 were impact damaged and bent aft. The push rod tubes for cylinders Nos. 1 and 2 were partially separated. Both magnetos and the starter remained attached to the engine. The spark plugs were removed and exhibited normal wear when compared to the Champion Check-a-Plug chart. The left and right magnetos were removed, but no spark was observed on any towers. Both magnetos were disassembled and the left magneto exhibited fire damage and there were no anomalies noted in the right magneto. A borescope was used to examine the cylinders and no anomalies were noted. The propeller hub remained attached to the propeller flange; however, both wooden propeller blades were impact separated from the propeller hub. Several wooden propeller blade sections were located within the impact crater.

MEDICAL AND PATHOLOGICAL INFORMATION

The Medical Examiner Department, District 19, of Florida, performed an autopsy on the pilot. The autopsy report indicated that the pilot died as a result of "multiple blunt trauma injuries" and the report listed those injuries.

The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicological testing of the pilot. Fluid and tissue specimens from the pilot tested negative for cyanide, ethanol, and other drugs.

TESTS AND RESEARCH

A GoPro camera was shipped to the NTSB Recorders Laboratory for data download. The camera and the memory card were undamaged. The memory card was read out normally.

A Recorder Laboratory Specialist reviewed the video and prepared a transcript of the events from the video camera. The video revealed that the camera was mounted on a suction mount hanging from the top of the sliding canopy looking forward. It captured the taxi, takeoff, and the accident flight in the traffic pattern of FPR. Immediately after liftoff, the airplane began large pitch oscillations up and down. Loose objects would rise into view and fall, coincident with the observed pitch oscillations. This pattern continued throughout the flight. The pilot's left forearm was moving fore and aft to control the airplane. The forearm was not resting on and stationary to the metallic armrest area of the airplane, which indicated that the pilot was moving the sidestick control primarily through forearm motion rather than wrist action. Throughout the initial climb, there were several other pitch oscillations. Then, the pilot turned the airplane onto the crosswind leg of the traffic pattern and his attention was diverted to the right, and immediately the airplane again began pitch oscillations. Next, the pilot turned onto the downwind leg of the traffic pattern, and again, diverted his attention, and adjusted his grip on the sidestick. While his hand was not on the sidestick, the airplane began another pitch oscillation.

When the pilot maneuvered the airplane onto the final leg of the traffic pattern, he readjusted his grip on the sidestick and moved his right hand to the throttle, at which time the airplane began pitch oscillations and the pilot's right hand was noted moving upward, off the throttle.

The pilot re-gripped the throttle and continued to line the airplane up with the intended runway for landing. A few seconds later, the airplane experienced a large pitch up, the pilot's hand moved downward and off the throttle, and the airplane had a positive pitch attitude. Immediately, the airplane experienced a large downward pitch oscillation and the canopy glass broke, the camera exited the airplane, and it rotated in the airstream behind the airplane. As the camera rotated, it captured the airplane until it impacted the ground, and soon after the camera came to rest in the vicinity of the airplane.

Throughout the accident flight, the airspeed of the airplane continuously increased to a maximum of about 160 mph while the airplane was on final approach to the runway. The pitch control inputs, pitch excursions, and energy of the objects rising into and falling from the camera view were increasing throughout the flight. The propeller was rotating, and the engine sound was smooth and continuous without interruption until the camera exited the airplane. In addition, during the video, the pilot was not observed utilizing any type of checklist.

Video Study

The GoPro video camera was mounted to the canopy of the airplane, aft and slightly to the right of the pilot. The instrument panel and both side stick controllers were in camera's recorded view. The pilot was using his left hand to control the left side stick.

Large fore/aft stick movements and corresponding pitch oscillations were observed from just after the takeoff to the end of the flight. There were periods where the stick movement and airplane pitch were relatively stable. The final pitch down culminated in a structural breakup where the seats separated from the airframe and the pilot was ejected through the airplane's canopy.

Overall, the pitch oscillations were consistent with the stick movements and both sticks moved in unison. Throughout the flight, the pilot did not rest his left arm to the armrest, rather the entire forearm was used to move the stick. In addition, the pilot released and re-gripped the stick several times. Repeatedly, the pilot would turn his head to the right and/or reach right, which resulted in the beginning of an oscillation. In each case, his left arm would move fore and aft and negative Gs were present in each of the pitch excursions except for the initial takeoff excursion. The speed of the airplane was steadily increasing throughout the flight, and on short final, the airspeed indicator indicated about 160 mph. The recording included the final excursion, which was similar to a negative G excursion, although no G-meter was observed it appeared to be a greater force than the previous excursions.

The airplane manufacturer stated that the purpose of the taxi tests was for the pilot to become familiar with the control feel and characteristics of the airplane and the side-stick control. A representative of the company said that the pilot was expected to be able to carefully lift the nose gear off the runway without taking off and repeat this maneuver several times prior to being considered eligible to fly the airplane. This type of maneuver was not observed on the video of the accident flight.

Stabilator Spar and Bracket Examination

The stabilator spar and bracket were examined by the NTSB Materials Laboratory in Washington, DC. Magnified optical examinations of the fracture revealed features and deformation patterns consistent with an overstress separation with no indications of preexisting cracking such as fatigue. The stabilator brackets left bearing loop was fractured with features indicative of an overstress separation. Fracture deformation was to the left. The

right hand bracket loop was intact. Deformation and contact marks were present at the bearing loop area consistent with leftward deflection of an attached clevis like structure. Both brackets showed shadow marks consistent with the presence of mounting hardware attaching the brackets to the common plate.

ADDITIONAL INFORMATION

Bedecorp – Flight Handbook

The manufacturer's flight handbook contained "...information and guidelines for learning to fly a BD aircraft. These procedures required for test flying an aircraft, as well as new pilots checking themselves out in an aircraft." In addition, "as a general rule, it takes three days before the pilot is cleared for their initial take off and flight around the pattern. It is recommended that a majority of the flight testing be done in the early morning hours while the wind is calm. It is also important to give the pilot time to absorb and digest the information from each of the following steps. The list below is a minimum amount that the company requires a new pilot to perform in order to be checked out in the aircraft." The flight procedures checklist indicated that the pilot was to start learning the specifics of that make and model of airplane by first taxiing, then performing high speed taxies, performing high speed taxies with the nose gear off the ground, and finally, after he or she was comfortable with the airplane, to perform a takeoff.

History of Flight

Approach-VFR pattern final	Abrupt maneuver (Defining event) Loss of control in flight Collision with terr/obj (non-CFIT)
----------------------------	---

Pilot Information

Certificate:	Flight Instructor; Commercial	Age:	66, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land; Single-engine Sea	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	Airplane Single-engine	Toxicology Performed:	Yes
Medical Certification:	Class 2 With Waivers/Limitations	Last Medical Exam:	12/11/2013
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:	4500 hours (Total, all aircraft), 0.4 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	BEDECORP LLC	Registration:	N224BD
Model/Series:	BD-22	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Experimental	Serial Number:	BD22-010
Landing Gear Type:	Tricycle	Seats:	2
Date/Type of Last Inspection:	Conditional	Certified Max Gross Wt.:	
Time Since Last Inspection:		Engines:	1 Reciprocating
Airframe Total Time:	1 Hours	Engine Manufacturer:	Lycoming Engines
ELT:	Not installed	Engine Model/Series:	O-235-L2C
Registered Owner:	BEDECORP LLC	Rated Power:	115 hp
Operator:	BEDECORP LLC	Air Carrier Operating Certificate:	None

Meteorological Information and Flight Plan

Observation Facility, Elevation:	FPR, 23 ft msl	Observation Time:	1053 EDT
Distance from Accident Site:	1 Nautical Miles	Condition of Light:	Day
Direction from Accident Site:	271 °	Conditions at Accident Site:	Visual Conditions
Lowest Cloud Condition:	Clear	Temperature/Dew Point:	22 °C / 16 °C
Lowest Ceiling:	None	Visibility	10 Miles
Wind Speed/Gusts, Direction:	8 knots, 280 °	Visibility (RVR):	
Altimeter Setting:	30.18 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Fort Pierce, FL (FPR)	Type of Flight Plan Filed:	None
Destination:	Fort Pierce, FL (FPR)	Type of Clearance:	VFR
Departure Time:	1055 EDT	Type of Airspace:	

Airport Information

Airport:	ST LUCIE COUNTY INTL (FPR)	Runway Surface Type:	Asphalt
Airport Elevation:	23 ft	Runway Surface Condition:	Dry
Runway Used:	28L	IFR Approach:	None
Runway Length/Width:	6492 ft / 150 ft	VFR Approach/Landing:	Traffic Pattern

Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	On-Ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Fatal		

Administrative Information

Investigator In Charge (IIC):	Heidi Moats	Adopted Date:	07/25/2016
Additional Participating Persons:	James Boles; FAA/FSDO; Orlando, FL Jim Bede; Bedecorp, LLC; Medina, OH		
Publish Date:	07/25/2016		
Note:	The NTSB traveled to the scene of this accident.		
Investigation Docket:	http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=90970		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report.