Aviation Investigation Final Report

Location:	Linden, New Jersey	**Accident Number:**	ERA13FA259
Date & Time:	May 31, 2013, 13:10 Local	**Registration:**	N176MA
Aircraft:	DIAMOND AIRCRAFT IND INC DA 20-C1	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	1 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

The flight instructor was conducting an introductory flight for the passenger. Witnesses reported observing the airplane lift off about two-thirds down the 4,140-ft-long, asphalt runway and then struggle to gain altitude. The passenger reported that, after takeoff, the flight instructor told him that the engine was not "making power." The flight instructor declared an emergency and was returning to the departure airport when the airplane stalled and impacted the ground about 1/2 mile northwest of the airport. Postaccident examination of the airframe and engine did not reveal any discrepancies that would have precluded normal operation.

Weight and balance calculations revealed that the airplane was likely at or above its maximum allowable takeoff weight during the accident flight. Further, the temperature about the time of the accident was about 94 degrees F, and the estimated density altitude at the airport was about 2,200 ft mean sea level. Based on these conditions, if the engine had been operating perfectly, its available power production would have been between about 81 and 85 percent. Therefore, it is likely that these conditions, in combination with the airplane being near or slightly above its maximum allowable weight, reduced the airplane's climb performance and that, while attempting to return to the airport, the pilot failed to maintain adequate airspeed and flew the airplane beyond its critical angle-of-attack, which led to an aerodynamic stall.

The flight instructor was ejected from the airplane during the impact after the right seatbelt quick release hook separated from its fuselage anchor. Examination of the quick release hook revealed that it was bent out of the plane of the attachment and twisted. In addition, the hook closure latch was also distorted and deformed. The combined deformations of the hook and latch allowed the hook to disengage. Although it is possible that the deformation occurred during the accident impact, it is more likely that preexisting deformation was present. The airplane had been operated for about 38 hours since its most recent 100-hour/annual inspection, which was performed about 3 weeks before the accident. A condition inspection

of the restraint system was required to be performed during this inspection; however, no record was found indicating whether the condition inspection was performed.

Probable Cause and Findings

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

The flight instructor's inadequate preflight planning and his decision to take off with the airplane at a high gross weight in high temperature conditions that degraded the engine's available power and his subsequent failure to maintain airspeed while attempting to return to the departure airport, which resulted in the airplane exceeding its critical angle-of-attack and experiencing an aerodynamic stall.

Findings

Personnel issues	Weight/balance calculations - Instructor/check pilot
Personnel issues	Performance calculations - Instructor/check pilot
Aircraft	Airspeed - Not attained/maintained
Aircraft	Angle of attack - Not attained/maintained
Personnel issues	Aircraft control - Instructor/check pilot
Environmental issues	High temperature - Effect on equipment
Aircraft	Maximum weight - Not specified
Personnel issues	Decision making/judgment - Instructor/check pilot

Factual Information

History of Flight

Prior to flight	Preflight or dispatch event
Maneuvering	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On May 31, 2013, about 1310 eastern daylight time, a Diamond Aircraft Industries Inc., DA20-C1, N176MA, was substantially damaged when it impacted the ground, shortly after takeoff from the Linden Airport (LDJ), Linden, New Jersey. The flight instructor was fatally injured and a passenger was seriously injured. Visual meteorological conditions prevailed and no flight plan had been filed for the local introductory instructional flight that was conducted under the provisions of 14 Code of Federal Regulations Part 91.

The airplane was owned by a limited liability company, and operated by Best-in-Flight, a flight school based at LDJ.

A witness at LDJ reported that the airplane departed from runway 27, a 4,140-foot-long, asphalt runway. The airplane's takeoff roll was longer than other DA-20s he was use to observing and it "struggled" to break ground and gain altitude. The airplane made a right turn at an estimated altitude of between 125 to 150 feet above the ground, and immediately started to lose altitude. It descended behind a building and he heard the pilot radio "mayday" over the airport's common traffic advisory frequency, stating "plane going down." He was then informed by the pilot of another airplane that the airplane had crashed. He further stated that while he could not hear the airplane's engine noise clearly because of a nearby highway, the engine noise was constant and he did not hear any power interruptions until after the impact.

Another witness, the pilot of a Mooney M20K, was holding on the runway when he observed the accident airplane lift off about two-thirds down the runway. The airplane's attitude was flat and it did not seem to be climbing. He began his takeoff roll shortly thereafter and while on the upwind climb, he noted the accident airplane was below his altitude, heading northwest on a 45-degree angle from the runway about 200 to 300 feet above the ground. He heard the accident pilot transmit "mayday-mayday-mayday" and announce either "engine trouble" or "engine out." He then heard the pilot say "turning back to the airport." He immediately thought to himself that the airplane was too low to try to turn back to the airport and that the pilot should have continued straight and attempted to land in one of the surrounding factory lots. He next observed the airplane heading back toward the airport. The airplane was in a nose high pitch attitude, when it "stalled." The right wing dipped, the airplane descended, spun a quarter-turn and impacted railroad tracks.

During an interview with a Federal Aviation Administration (FAA) inspector, the passenger reported that the flight instructor told him that he had his feet on the brakes during the takeoff roll, and to place his feet flat on the floor, which he did. After takeoff, the flight instructor told him that the engine "wasn't making power." The flight instructor called "mayday" and was trying to return to the airport when the

airplane suddenly impacted the ground.

Radar data provided by the FAA for the Newark Liberty International Airport, which was located about 5 miles northeast of the accident site revealed the accident airplane departed runway 27, and made a right turn to the north before radar contact was lost about 1 minute after takeoff. The target identified as the accident airplane did not climb above an altitude of 200 feet.

The airplane struck and came to rest on abandoned railroad tracks on the site of a former automotive factory about a 1/2-mile northwest of LDJ. The site contained several deteriorated asphalt parking lots adjacent to the south-southwest side of the railroad tracks.

Flight instructor Information

Certificate:	Commercial; Flight instructor	**Age:**	58
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	August 6, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 4400 hours (Total, all aircraft), 640 hours (Total, this make and model), 200 hours (Last 90 days, all aircraft), 44 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

The flight instructor, age 58, held a commercial pilot and a flight instructor certificate, with ratings for airplane single-engine land and instrument airplane. His most recent FAA second-class medical certificate was issued on August 6, 2012.

According to the owner of the flight school, the flight instructor was hired during February 2011 and maintained a fulltime schedule as bookings permitted. The flight instructor's total flight experience at the time of the accident was about 4,400 hours, which included about 640 hours in the same make and model as the accident airplane. The flight school reported that the flight instructor had accumulated about 200 and 45 hours of total flight experience, which included about 160 and 35 hours in the same make and model as the accident airplane, during the 90 and 30 days that preceded the accident; respectively.

Aircraft and Owner/Operator Information

Aircraft Make:	DIAMOND AIRCRAFT IND INC	**Registration:**	N176MA
Model/Series:	DA 20-C1	**Aircraft Category:**	Airplane
Year of Manufacture:	2005	**Amateur Built:**	
Airworthiness Certificate:	Utility	**Serial Number:**	C0345
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	May 10, 2013 Annual	**Certified Max Gross Wt.:**	1760 lbs
Time Since Last Inspection:	38 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1985 Hrs at time of accident	**Engine Manufacturer:**	CONT MOTOR
ELT:	C91A installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-240-B
Registered Owner:	NC Cuthbert LLC	**Rated Power:**	125 Horsepower
Operator:	Best-in-Flight	**Operating Certificate(s) Held:**	None

The two-seat, low-wing, fixed-gear, airplane, serial number C0345, was manufactured in 2005 and primarily constructed of carbon and glass fiber reinforced polymer. It was powered by a Continental Motors Inc. IO-240-B, 125-horsepower engine, equipped with a two-bladed Sensenich wooden propeller. The airplane was certified in the utility category by Transport Canada in accordance with Canadian Airworthiness Manual Chapter 523-VLA.

Review of maintenance records revealed that the airplane had been operated for about 1,985 hours since new, and 38 hours since its most recent "100hr/annual" inspection, which was performed on May 10, 2013. At the time of the accident, the engine had been operated for about 2,180 total hours. It was noted that the engine was disassembled, inspected, and repaired for a sudden stoppage during May 2008.

According to the airplane flight manual, the airplane's total fuel capacity was 24.5 gallons. According to the owner of the airplane and flight school, the airplane was "topped-off" with fuel the night before and was flown without incident for 2.6 hours prior to the accident. The airplane consumed between 4.5 and 6.0 gallons per hour (gph); however, he noted that consumption was generally "closer to 4.5 gallons" during flight school operations.

The owner further reported that performing a weight and balance calculation was part of the preflight checklist and that weight and balance forms for the airplane were available on tables in the flight school; however, flight instructors would normally ask passengers their weight and perform the weight and balance calculation mentally.

A weight and balance calculation for the accident flight was performed utilizing an airplane weight and balance form specific to the accident airplane that was available at the flight school. Based on the passenger's reported weight of 290 pounds and the flight instructor's weight during his most recent FAA medical certificate of 235 pounds, the airplane was estimated to be about 30 pounds above its maximum takeoff weight of 1,764 pounds. The airplane's center of gravity was within limits.

When asked if he would fly with a passenger that weighed about 290 pounds, the owner stated that he would not, and would use the opportunity to convince the passenger to fly in the DA-40, which was equipped with a 180-horsepower engine.

The owner felt that the accident airplane was "overpowered" with its 125 horsepower engine. He also stated that he was aware that it was "very hot" at the time of the accident and if the reported temperature at the airport was 93 degrees Fahrenheit (about 34 degrees C), it was likely over 100 degrees F on most of the airport property.

Both cockpit seats were equipped with a four-point safety belt. Each seat was equipped with two inertia reels that were secured to the aft bulkhead for shoulder restraint. The lap belts were connected via a quick release/spring loaded clip-type fitting which hooked to an attach point that was embedded in the floor of the fuselage on their respective outboard sides, and to a center tunnel attach point on their respective inboard sides. Each quick release was secured with a cotter pin. According to a representative of the aircraft manufacturer, at that time of certification, the airplane's seat and seat belt attachments were designed for a 9g forward, 1.5g sideward load, and a 190 pound occupant.

The aircraft maintenance manual, maintenance practices 100 hour inspection checklist requirements included "…Examine the safety belts for general condition and security of the metal fitting in the surrounding composite…."

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	LDJ,22 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	13:15 Local	**Direction from Accident Site:**	300°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	220°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	30.07 inches Hg	**Temperature/Dew Point:**	34°C / 16°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Linden, NJ (LDJ)	**Type of Flight Plan Filed:**	None
Destination:	Linden, NJ (LDJ)	**Type of Clearance:**	None
Departure Time:	13:08 Local	**Type of Airspace:**	

The reported weather at LDJ, which was at an elevation of 22 feet mean sea level, at 1315, was: wind 220 degrees at 5 knots; visibility 10 statute miles; sky clear, temperature 34 degrees Celsius (C); dew point 16 degrees C; altimeter 30.08 inches of mercury.

The estimated density altitude at LDJ at the time of the accident was about 2,200 feet mean sea level.

Airport Information

Airport:	Linden LDJ	**Runway Surface Type:**	Asphalt
Airport Elevation:	22 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	27	**IFR Approach:**	None
Runway Length/Width:	4140 ft / 100 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious	**Latitude, Longitude:**	40.621665,-74.252777

All major portions of the airplane were accounted for at the accident site. The airplane was found upright, with the nose down about 45 degrees. The right wing was displaced aft and folded underneath the fuselage. The empennage was separated about 4 feet forward of the rudder and was resting partially on the ground.

Examination of the ailerons, elevator, and rudder control systems did not reveal any preimpact malfunctions. The flap actuator was found in the takeoff position, and the elevator trim actuator was found in the neutral/takeoff position. An undetermined amount of fuel had leaked on the ground and additional fuel was observed leaking from an area around the engine driven fuel pump, which was separated and impact damaged. Fuel samples obtained from the gascolater and fuel tank sump were absent of contamination. The fuel shutoff valve was in the OPEN position. The mixture control linkage was continuous from the engine to the cockpit. The throttle control linkage was connected at the engine; however, the rod end at the cockpit was impact damaged, bent, and broken.

The engine sustained significant impact damage and remained attached to the airframe primarily by linkages to the throttle quadrant. The lower front portion of the crankcase was fractured consistent with impact with the ground. All of the cylinders remained attached to the crankcase. The right magneto remained attached. The left magneto was separated and remained attached to the engine via ignition leads. The top spark plugs were removed and exhibited normal operating signatures in accordance with a Champion aviation check-a-plug comparison chart. Their electrodes were intact and dark gray in color. The fuel pump drive coupling was intact and the drive shaft rotated freely when turned by hand. All cylinders were inspected using a lighted borescope. The cylinder bores were free of scoring and no evidence of hard particle passage was observed in the cylinder bore ring travel area. Suction and compression were obtained on all cylinders at the top spark plug holes when the crankshaft was rotated by hand at the crankshaft flange.

The propeller hub remained attached to the engine. One propeller blade was fractured at the hub, and the second propeller blade was separated about 2 feet outboard of the hub. Several small propeller blade fragments were observed scattered around the accident site.

Subsequent disassembly of the engine, which included bench testing of both magnetos, the fuel pump, throttle body, manifold valve and fuel nozzles did not reveal any anomalies that would have precluded normal engine operation.

The left and right seatpans were attached to the aft cockpit bulkhead wall with seven screws (five along the top of the seatpan, and two screws on the bottom forward edge of the seatpan). The left seatpan contained a fracture on the bottom of the pan under a leather insert, a fracture in the middle of the seatpan, and a crushing damage on the inboard edge of the seatpan. The right seatpan contained a fracture along its outboard edge and a section of separated composite material near the inboard forward corner. The left seat restraint system remained intact. The right seat outboard lap belt was found disconnected from its attach point. The quick release hook was distorted and the cotter pin remained installed. [Additional information can be found in the Survival Factors Factual Report located in the public docket.]

The complete right seat restraint system and portions of the left seat restraint system were subsequently removed and forwarded to the NTSB Materials Laboratory, Washington, DC for further examination.

Medical and Pathological Information

First responders reported that the flight instructor, who was seated in the right seat, was ejected from the airplane. He was located next to the wreckage and was unresponsive.

An autopsy was subsequently performed on the flight instructor by the Union County Medical Examiner's Office, Westfield, New Jersey. The autopsy report revealed the cause of death as "blunt impact injuries."

Toxicological testing was performed on the pilot by the FAA Bioaeronautical Science Research Laboratory, Oklahoma City, Oklahoma, with no anomalies noted.

Tests and Research

Examination of the occupant restraint system performed by an NTSB metallurgist revealed the left seat quick release hook was intact and not deformed. The right seat quick release hook was bent out of the plane of the attachment and twisted. In addition, the hook closure latch was also distorted and deformed. The combined deformations of the hook and latch were such that the spring closure on the latch did not function and the throat of the hook was open, which would allow the hook to engage or disengage on the

anchor with the properly installed cotter pin in-place. [Additional information can be found in the Materials Laboratory Factual Report located in the public docket.]

A representative from Diamond Aircraft calculated the available engine power during the accident flight based on the airport elevation and the outside air temperature, using flight test data to determine target manifold pressures and the average full power engine RPM. At an RPM of 2,500, and manifold pressures of 27 and 28 inches of mercury, chart brake horsepower was 101.4 (approximately 81 percent power being produced) and 105.9 (approximately 84.7 percent power being produced); respectively. The calculations represented a perfect operating engine and did not take into account engine wear, cylinder compression losses, and fuel system setup conditions.

Administrative Information

Investigator In Charge (IIC):	Schiada, Luke
Additional Participating Persons:	Wayne Van Steenburg; FAA\FSDO; Teterboro, NJ Kurt A Gibson; Continental Motors, Inc.; Mobile, AL Randy Burt; Diamond Aircraft; London
Original Publish Date:	June 1, 2015
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=87047