Aviation Investigation Final Report

Location:	Highgate, Vermont	**Accident Number:**	IAD05LA085
Date & Time:	June 26, 2005, 13:00 Local	**Registration:**	UNREG
Aircraft:	Martel Air Command 532Elite	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot purchased the used gyroplane about 2 weeks prior to the accident. After assembling it, and 2 days before the accident, he conducted a series of touch and go landings, or "crow hops" along a runway. The day before the accident flight was his first flight. During the accident flight, a main rotor blade "folded," and the gyroplane descended nose first into wooded terrain. Examination of the wreckage revealed airframe and rotor blade marks, consistent with retreating rotor blade stall, which could have resulted from either pilot input or "a sharp downdraft." Winds, about the time of the accident, at an airport 25 nautical miles to the south, were 7 knots, with no wind gusts reported. The make and model of gyroplane was known to be unstable, and the pilot was at least aware of a recommended upgrade kit to enhance stability, but had not installed it. The pilot was not rated in gyroplanes, and had spoken to a flight instructor about training, but then decided to self-train. The pilot also did not possess a repairman's certificate for the gyroplane.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's improper cyclic input, which resulted in a retreating rotor blade stall, and its subsequent impact with the propeller. Also causal, was the pilot's failure to acquire proper training. A factor was the pilot's decision not to have a stability upgrade kit installed prior to flying the gyroplane.

Findings

Occurrence #1: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: CRUISE

Findings
1. (C) AIRCRAFT HANDLING - IMPROPER - PILOT IN COMMAND
2. (C) INADEQUATE TRAINING - PILOT IN COMMAND
3. RETREATING BLADE STALL - PILOT IN COMMAND
4. (F) MAINTENANCE,MODIFICATION - NOT PERFORMED - PILOT IN COMMAND
5. ROTOR SYSTEM,MAIN ROTOR BLADE - BLADE STRIKE

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

Findings
6. TERRAIN CONDITION - GROUND

Factual Information

On June 26, 2005, about 1300 eastern daylight time, an amateur-built, unregistered Air Command 532 Elite gyroplane was substantially damaged when it impacted trees and terrain in Highgate, Vermont. The certificated private pilot was fatally injured. Visual meteorological conditions prevailed, and no flight plan had been filed for the local flight, which originated at Franklin County State Airport (FSO), Highgate, Vermont. The personal flight was conducted under 14 CFR Part 91.

According to a Vermont State Police report, the pilot's daughter stated that he had purchased the gyroplane (used) about 2 weeks before the accident. As far as she knew, the pilot assembled it himself, and was thinking about modifying it, but had not done so by the time of the accident. She also noted that the pilot was not taking any lessons, and that he was learning to fly it on his own.

Another pilot confirmed with police that the accident pilot had purchased the gyroplane about 2 weeks previously. On June 24, 2006, the accident pilot performed touch and go landings, or "crow hops," along the runway, and on the day before the accident, the accident pilot flew the gyroplane for the first time.

On the day of the accident, a local sheriff was at the airport when he observed the gyroplane, about 800 feet in the air, with "some type of mechanical failure." He then saw the gyroplane "go straight down into [a] heavily wooded area."

Another witness saw the gyroplane take off, and about 500 feet, the "the blade folded," and the gyroplane "went down."

A third witness noticed "the propeller not working," before the gyroplane "went straight down with the front end first," while a fourth witness thought "the rotor was barely moving" before seeing the gyroplane descend vertically.

According to a Federal Aviation Administration (FAA) inspector, the wreckage was located about 1 mile east of the runway, in wooded terrain. Fuel was found at the scene and in the fuel filter, and the propeller was hand-turned "without difficulty."

According to an FAA-approved basic flight instructor (BFI), the accident pilot had phoned him and asked about lessons, as he was buying a gyroplane. The flight instructor was familiar with the gyroplane, as he had seen it operated at fly-ins by the original owner. He urged the accident pilot to convert it to the manufacturer's then-current approved configuration, using an upgrade kit the manufacturer sold. The flight instructor understood that the accident pilot had acquired the upgrade kit, but elected to fly prior to installing it. The kit lengthened the tail

boom and raised the seat to bring the center of gravity in line with the propeller thrust line. The instructor knew of no similar accidents in the upgraded version of the gyroplane, "in contrast to a dozen or more accidents similar to this one in the unmodified originals."

The flight instructor further stated that he was familiar with the accident model of gyroplane because he had owned and flew an earlier model for a number of years. His was lighter, simpler, and a lower-powered version, but its center of gravity was 5-6 inches below the propeller thrust line. He put 300-400 hours on it, but "eventually grounded it because of its pitch stability problems. These qualities made it very unpleasant to fly in even routine thermal turbulence."

The flight instructor also stated to the FAA inspector that the accident model was "very unstable in the best of hands," and that he understood how a novice could have difficulty flying one.

The flight instructor subsequently had an opportunity to examine parts of the wreckage. According to his observations, the vertical main rotor spindle that was attached to a ring gear was bent 25-30 degrees to the left. The ring gear, which spun above the spindle and was normally in a plane parallel to the top surface of the torque bar, was tilted to the left of the top surface of the torque bar.

There were also deep gouges on the front end of the torque bar, which corresponded with the positions of bolts that held the main bearing assembly together. The main bearing assembly would normally rotate just above the torque bar, with the ring gear, and the bolts would clear the bar. Contact between the bolts and the torque bar would have been consistent with violent bending loads having been placed on the main spindle bolt.

The main rotor bearing was not seized and could be spun easily by hand. Except for saw cuts made by the recovery crew, the control pushrods were bent but continuous.

The flight instructor also noted that the propeller thrust line was located 8-10 inches above the center of gravity on the unmodified (accident) model of gyroplane. The horizontal stabilizer was small and close-coupled. If the rotor thrust was interrupted, either by pilot input or a sharp downdraft while the throttle setting was high, propeller thrust would cause a violent nose-down rotation of the airframe. Such a rotation would then result in a cyclic pitch change to the rotor, overpowering pilot control inputs. Since the rotor spun counterclockwise (from above), there would be a pitch increase to the retreating blade on the gyrocopter's left side. The blade (which already operated at a higher angle of attack than the advancing blade because its airspeed was lower) could then stall if the cyclic pitch input were large and sudden enough. That, in turn, would result in the blade on the left to descend as it proceeded through the left-rear sector of the rotor disk. Such motion, if the rotor flexed down beyond its normal flapping stops, would allow the rotor to contact the propeller and the drive gear for the pre-spin mechanism, as well as potentially bend the spindle bolt to the left or aft. If the stalled blade hit the propeller, it could fold up as seen by the witnesses.

The accident pilot held a private pilot certificate with a single engine land rating. The pilot's latest FAA third class medical certificate was attained on April 4, 1998. At the time, the pilot reported 2,350 hours of flight time. Flight time since that date was unknown. The pilot did not hold a repairman's certificate for the gyroplane.

An autopsy was performed on the pilot by the Office of the Chief Medical Examiner, Vermont State Department of Health, Burlington, Vermont. Toxicological testing was performed by the FAA Forensic Toxicology Team, Oklahoma City. Oklahoma.

Weather, reported at an airport about 25 nautical miles to the southwest, at 1253, included clear skies, winds from 120 degrees true, at 7 knots, a temperature of 84 degrees Fahrenheit, and a dew point of 64 degrees Fahrenheit.

Pilot Information

Certificate:	Private	**Age:**	66,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Single
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	None	**Last FAA Medical Exam:**	April 1, 1998
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	2350 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Martel	**Registration:**	UNREG
Model/Series:	Air Command 532Elite	**Aircraft Category:**	Gyroplane
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	1
Landing Gear Type:	Tricycle	**Seats:**	1
Date/Type of Last Inspection:	Unknown	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:		**Engine Manufacturer:**	Rotax
ELT:	Not installed	**Engine Model/Series:**	532
Registered Owner:	Joseph R. Benjamin	**Rated Power:**	65 Horsepower
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	PLB,371 ft msl	**Distance from Accident Site:**	25 Nautical Miles
Observation Time:	12:53 Local	**Direction from Accident Site:**	230°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	120°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.12 inches Hg	**Temperature/Dew Point:**	29°C / 18°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Highgate, VT (FSO)	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	

Airport Information

Airport:	Franklin County State FSO	**Runway Surface Type:**	
Airport Elevation:	228 ft msl	**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	Unknown
Runway Length/Width:		**VFR Approach/Landing:**	Unknown

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	44.939998,-73.083335

Administrative Information

Investigator In Charge (IIC):	Cox, Paul
Additional Participating Persons:	Ted Domin; FAA/FSDO; Portland, ME
Original Publish Date:	August 29, 2006
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=61804