



# Aviation Investigation Final Report

<b>Location:</b>	Argyle, New York	<b>Accident Number:</b>	ERA21FA317
<b>Date &amp; Time:</b>	August 7, 2021, 18:00 Local	<b>Registration:</b>	N162KJ
<b>Aircraft:</b>	Rotorway Exec 162F	<b>Aircraft Damage:</b>	Destroyed
<b>Defining Event:</b>	Abrupt maneuver	<b>Injuries:</b>	2 Fatal
<b>Flight Conducted Under:</b>	Part 91: General aviation - Personal		

## Analysis

A witness reported observing the helicopter flying southbound at an altitude of about 50 to 75 ft above ground level. The witness stated that the helicopter was “having issues” and “could not stay up in the air.” The witness further stated that the helicopter seemed as if it were “bouncing” as it flew across a field. Just after the helicopter flew over a tree line, the witness heard a “loud sound” and “watched the [rotor] just stop.” The helicopter then “fell straight down.”

Examination of the wreckage revealed that the lower inboard ends of the main rotor blade grips were bent upward and that both had semicircular indentations with the same diameter as the rotor mast. This damage was consistent with the blade grips contacting the mast, commonly referred to as mast bumping, which occurs due to excessive flapping motion of rotor blades (specifically, up-and-down motion of the blade tips).

The aft tailboom was separated from the helicopter and found about halfway along the 400-ft-long wreckage path. An impact mark consistent with the shape of the main rotor blade was found at the forward end of the separated section, consistent with a main rotor blade severing the tailboom.

Teetering rotor systems, such as the one on the accident helicopter, are particularly susceptible to mast bumping during low-G conditions, which can result from abrupt forward (nose-down) cyclic inputs. The witness’s description of the helicopter appearing to bounce as it was flying is consistent with repeated abrupt control inputs resulting in oscillating low-G conditions. These inputs likely led to the mast bumping and excessive blade flapping, which resulted in a main rotor blade contacting the tailboom. The reason for the pilot’s abrupt control inputs could not be determined.

Toxicology testing of the pilot's specimens detected ethanol and n-propanol, diphenhydramine), trazadone, and a metabolite of clonazepam. The ethanol was detected in the pilot's blood at low levels (below those considered to be impairing) and was not detected in his urine. That information, along with the presence of n-propanol in the pilot's blood, suggested that the ethanol was from sources other than ingestion and that it likely was not a factor in the accident. The diphenhydramine results were also below the therapeutic level; therefore, that medication was not likely a factor.

The pilot had been denied a Federal Aviation Administration medical certificate due to his medical history, which included bipolar disorder and depression. The detection of trazadone (which was well below therapeutic levels) and a metabolite of clonazepam indicated that he had been taking these medications to treat diagnosed conditions. However, the toxicological results suggested that the pilot's use of these medications was likely not a factor in the accident.

Toxicology testing also detected Delta-9-tetrahydrocannabinol (THC), which showed that the pilot had used cannabis. Although the effects of THC can last a few hours, THC can be detected in the body for days or weeks. Thus, the investigation could not determine if the pilot's use of cannabis could have been impairing and influenced his behavior during the accident flight.

## Probable Cause and Findings

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

The pilot's abrupt control inputs, which resulted in a low-G condition, main rotor mast bumping, and the subsequent severing of the tail boom by a main rotor blade.

### Findings

<b>Aircraft</b>	Main rotor mast/swashplate - Related operating info
<b>Personnel issues</b>	Aircraft control - Pilot

# Factual Information

## History of Flight

Maneuvering	Abrupt maneuver (Defining event)
Maneuvering	Mast bumping
Maneuvering	Part(s) separation from AC
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On August 7, 2021, about 1800 eastern daylight time, an experimental amateur-built Rotorway Exec 162F, N162KJ, was destroyed when it was involved in an accident in Argyle, New York. The pilot and passenger were fatally injured. The helicopter was operated as a Title 14 Code of Federal Regulations Part 91 personal flight.

A witness located about 1/2 mile north of the accident site observed the helicopter flying southbound at an estimated altitude of 50 to 75 ft above ground level. The witness stated that he thought that the helicopter was “having issues, as the helicopter could not stay up in the air.” The witness stated that it seemed “almost like [the helicopter] was bouncing” as it flew across a field. Just after the helicopter flew over a tree line, the witness heard a “loud sound” and “watched the [rotor] just stop.” The helicopter then “fell straight down.” A postimpact fire ensued.

The pilot did not possess a rotorcraft-helicopter rating. His logbook included two 90-day endorsements for solo flight, the latest of which expired in June 2004. His most recent valid medical certificate was issued in 2000. In 2016, the Federal Aviation Administration (FAA) denied his application for medical certification due to medical history, which included bipolar disorder and depression. The pilot completed the build of the helicopter in May 2003.

Postaccident examination of the accident scene revealed a debris path that was about 400 ft long and oriented on a magnetic heading of 210°. The debris path began in an open field of 4-ft-tall grass with a 4 inch-by-4 inch fractured piece of aluminum skin from the right side of the tailboom, just forward of the tail rotor arc. The right horizontal stabilizer was located 156 ft along the wreckage path, 70 ft left of the path centerline. The left horizontal stabilizer was located about 10 ft farther along the debris path and 205 ft left of the path centerline.

A 4-ft-long section of the aft end of the tailboom, including the vertical stabilizer and the tail rotor gearbox (with one tail rotor blade attached), was located 30 ft farther down the path, 10 ft left of centerline, just after the path transitioned from the grass field to the tree line and into a wooded area. An impact mark on the right side of the tailboom section, near the fractured forward end, was consistent in size and shape with the profile of the main rotor blade. The

wreckage path continued for another 200 ft through the woods and down a steep hill, with numerous fragments of clear plastic canopy along and to the left and right of the path.

The main wreckage, which was located at the end of the path, came to rest on its right side and top, almost completely inverted. The wreckage was largely consumed by the postimpact fire. Molten aluminum remnants were present at several locations beneath the main wreckage. No ground scars were observed leading up to the main wreckage, and the trees and foliage along the wreckage path were not damaged, except for some broken branches directly above, and immediately surrounding, the main wreckage.

Control continuity was established from the anti-torque pedals to the tail rotor through breaks in the push-pull cable. Continuity from the cockpit controls to the teetering main rotor head was partially established; several components in the push-pull cable system were not found.

Both main rotor blades were intact and attached to the blade grips, and both blades exhibited downward bending damage in several locations. The teetering hinge attach points were fractured on both sides of the hub plate. One rotor blade had leading-edge damage and gouging about 1 to 2 ft inboard of the blade tip. Both pitch change links were fractured at their upper (blade end) rod ends, and both links remained attached to fractured segments of their lower control horns. The inboard ends of both lower blade grips were bent upward, and each had semicircular deformation consistent with the diameter of the rotor mast, as shown in figure 1.

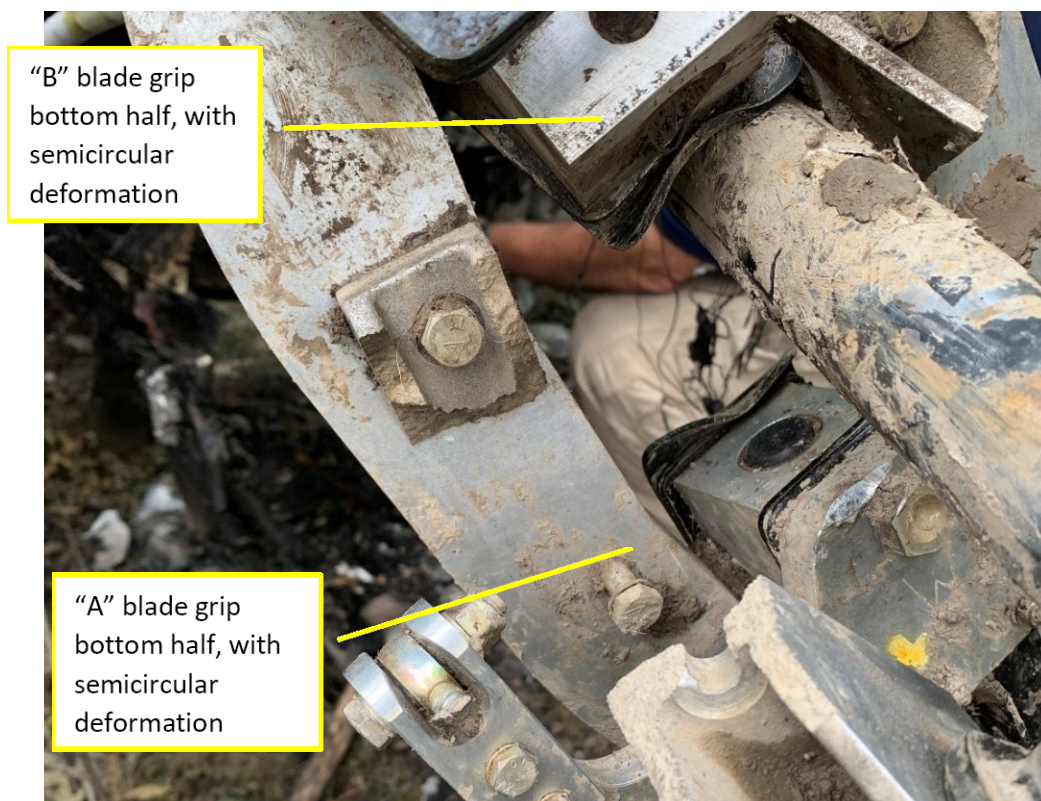


Figure 1 - Damage to blade grips.

Toxicology testing by the FAA Forensic Sciences Laboratory detected ethanol in the pilot's blood; no ethanol was detected in his urine. N-propanol (a microbial product) was detected in his blood. Diphenhydramine, trazodone, and 7-aminoclonazepam (the inactive metabolite of clonazepam) were detected in his blood and urine. Delta-9-tetrahydrocannabinol (THC), 11-hydroxy-delta-9-THC, and carboxy-delta-9-tetrahydrocannabinol were also detected in the pilot's blood and urine.

According to the FAA, diphenhydramine and trazodone (used to treat depression, anxiety, and insomnia) are both sedating but can be acceptable for use if taken with sufficient waiting periods before flying; trazodone is disqualifying if used to treat bipolar disorder. Clonazepam is disqualifying due to the underlying condition it treats (panic disorders). The use of marijuana is addressed by 14 *Code of Federal Regulations* 91.17(a)(3), which states that "no person may act or attempt to act as a crewmember of a civil aircraft...while using any drug that affects the person's faculties in any way contrary to safety."

The FAA's *Helicopter Flying Handbook* describes low-G conditions and mast bumping, stating in part the following:

*Helicopters with two-bladed teetering rotors rely entirely on the tilt of the thrust vector for control. Therefore, low-G conditions can be catastrophic for two-bladed helicopters....*

*Abrupt forward cyclic input or pushover in a two-bladed helicopter can be dangerous and must be avoided, particularly at higher speeds. During a pushover from moderate or high airspeed, as the helicopter noses over, it enters a low-G condition. Thrust is reduced, and the pilot has lost control of fuselage attitude but may not immediately realize it. Tail rotor thrust or other aerodynamic factors will often induce a roll. The pilot still has control of the rotor disk, and may instinctively try to correct the roll, but the fuselage does not respond due to the lack of thrust. If the fuselage is rolling right, and the pilot puts in left cyclic to correct, the combination of fuselage angle to the right and rotor disk angle to the left becomes quite large and may exceed the clearances built into the rotor hub. This results in the hub contacting the rotor mast, which is known as mast bumping...and the energy and inertia in the rotor system can sever the mast or allow rotor blades to strike the tail or other portions of the helicopter.*

The handbook included an illustration that depicted the hub contacting the rotor mast, as a result of improper corrective action in a low-G condition (figure 2).

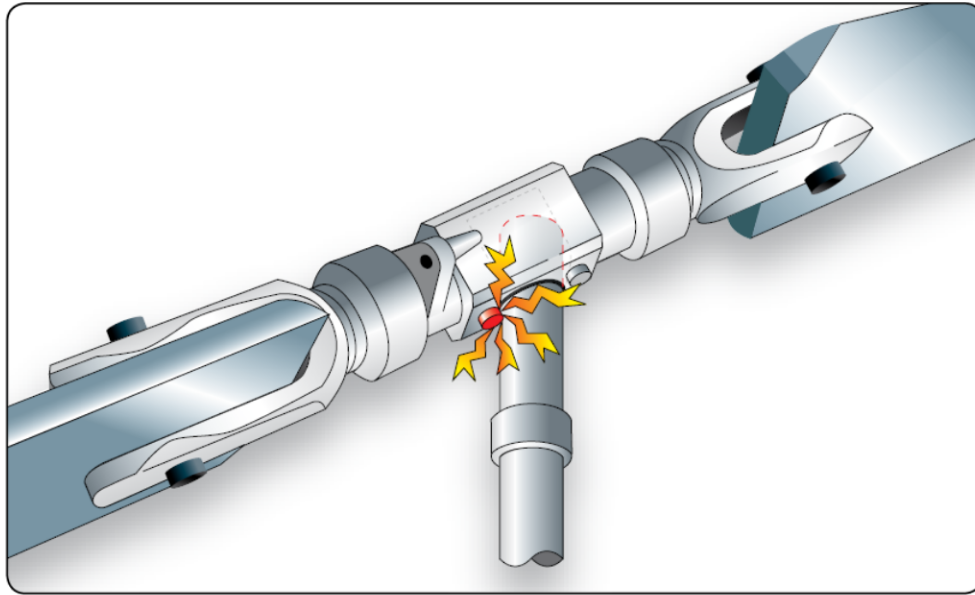


Figure 2. Mast bumping illustration (Source: FAA *Helicopter Flying Handbook*).

## Pilot Information

<b>Certificate:</b>	Private	<b>Age:</b>	56,Male
<b>Airplane Rating(s):</b>	Single-engine land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Unknown
<b>Instrument Rating(s):</b>	None	<b>Second Pilot Present:</b>	No
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	None	<b>Last FAA Medical Exam:</b>	March 24, 2014
<b>Occupational Pilot:</b>	No	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>	(Estimated) 500 hours (Total, all aircraft)		



## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Rotorway	<b>Registration:</b>	N162KJ
<b>Model/Series:</b>	Exec 162F	<b>Aircraft Category:</b>	Helicopter
<b>Year of Manufacture:</b>	2003	<b>Amateur Built:</b>	Yes
<b>Airworthiness Certificate:</b>	Experimental (Special)	<b>Serial Number:</b>	6692
<b>Landing Gear Type:</b>	Skid	<b>Seats:</b>	2
<b>Date/Type of Last Inspection:</b>		<b>Certified Max Gross Wt.:</b>	1500 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	1 Reciprocating
<b>Airframe Total Time:</b>		<b>Engine Manufacturer:</b>	Rotorway
<b>ELT:</b>	Installed	<b>Engine Model/Series:</b>	RI162F
<b>Registered Owner:</b>	On file	<b>Rated Power:</b>	150 Horsepower
<b>Operator:</b>	On file	<b>Operating Certificate(s) Held:</b>	None

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	DDH,826 ft msl	<b>Distance from Accident Site:</b>	22 Nautical Miles
<b>Observation Time:</b>	17:54 Local	<b>Direction from Accident Site:</b>	149°
<b>Lowest Cloud Condition:</b>	Scattered / 9000 ft AGL	<b>Visibility</b>	10 miles
<b>Lowest Ceiling:</b>		<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	4 knots /	<b>Turbulence Type Forecast/Actual:</b>	/
<b>Wind Direction:</b>	210°	<b>Turbulence Severity Forecast/Actual:</b>	/
<b>Altimeter Setting:</b>	30.01 inches Hg	<b>Temperature/Dew Point:</b>	27°C / 21°C
<b>Precipitation and Obscuration:</b>	No Obscuration; No Precipitation		
<b>Departure Point:</b>	Argyle, NY	<b>Type of Flight Plan Filed:</b>	None
<b>Destination:</b>	Argyle, NY	<b>Type of Clearance:</b>	None
<b>Departure Time:</b>		<b>Type of Airspace:</b>	Class G

## Wreckage and Impact Information

<b>Crew Injuries:</b>	1 Fatal	<b>Aircraft Damage:</b>	Destroyed
<b>Passenger Injuries:</b>	1 Fatal	<b>Aircraft Fire:</b>	On-ground
<b>Ground Injuries:</b>		<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	2 Fatal	<b>Latitude, Longitude:</b>	43.210144,-73.506795



## Administrative Information

**Investigator In Charge (IIC):** Brazy, Douglass

**Additional Participating Persons:** Mike Bush; FAA/FSDO; Albany, NY

**Original Publish Date:** August 30, 2023

**Last Revision Date:**

**Investigation Class:** [Class 3](#)

**Note:**

**Investigation Docket:** <https://data.nts.gov/Docket?ProjectID=103652>

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