

Investigation Report

Identification

Type of Occurrence:	Accident
Date:	16 November 2008
Location:	Near Nordhorn
Aircraft:	Helicopter
Manufacturer / Model:	Rotorway / Exec 162 F
Injuries to Persons:	Pilot fatally injured
Damage:	Aircraft destroyed
Other Damage:	Crop damage
Source of Information:	Investigation by BFU
State File Number:	BFU CX012-0/08

Factual Information

History of the Flight

On the day of the accident the pilot, accompanied by a woman friend, flew from Teuge aerodrome (Netherlands) to Nordhorn-Lingen aerodrome (Germany) with the intention of showing his Rotorway Exec 162F helicopter to his ex-flying instructor, who on this day was giving flying instruction at Nordhorn in a Robinson R44. After inspecting the helicopter on the ground, it was agreed that they would undertake a joint flight together to take air-to-air photos of the Exec 162F.

The two helicopters took off together in formation at 12:44 ¹. The Robinson R44 was occupied by the flying instructor, a student pilot and the Exec pilot's woman friend. The Exec 162F pilot was alone in the helicopter. The R44 flew ahead, followed to the left and rear by the Exec 162F. The two-helicopter formation flew towards the south-west while climbing and left the airfield circuit area.

The flying instructor subsequently stated that, after reporting departure from Nordhorn Aerodrome, he had suggested a change of frequency to 123.45 MHz to coordinate the photography. At this moment, the two helicopters were about 60 – 100 m apart, flying at a height of about 800 – 1 000 ft at a speed of 70 – 75 kt. The helicopter instructor in the R44 subsequently stated that he had changed frequency, but lost sight of the other helicopter. He thought he had seen the Exec 162F from the corner of his eye climbing and disappearing to the left rear, and then disappearing behind the R44. This observation was confirmed by the woman friend, who occupied the left rear seat of the R44.

The R44 flew straight ahead and the flying instructor then attempted to make radio contact with the other helicopter on the new frequency. Failing to do so, he changed back to the Nordhorn aerodrome frequency and again attempted to make contact with the other helicopter. This attempt was also unsuccessful and he then flew a gentle turn to the left in an attempt to re-establish visual contact with the Exec 162 F. However, he was unable to see other helicopter. Uncertain of what had happened to the other helicopter, the flying instructor decided to return to the aerodrome.

On the ground, a forestry worker reported he had heard two metallic bangs; he subsequently stated he had seen a helicopter in the air nearby from which parts were flying off. The helicopter blades were not rotating, and the machine fell from the sky towards him. He alarmed the rescue services at 12:46.

The Exec 162 F fell to the ground at the edge of a field about 100 m from where the forestry worker stood, and burned out.

¹ All times local, unless otherwise stated

Personnel Information

The 45 year-old pilot had a valid Helicopter Private Pilot's Licence (PPL(H)) first issued on 27.07.2007 by the Netherlands Civil Aviation Authority. The licence had type ratings for the HU 269 and Exec 162, valid to 01.09.2008 and 01.11.2009 respectively. He had a Class 2 Medical Certificate valid to 26.09.2009.

His total flight time on helicopters was about 54 hours, of which about nine hours were on the type in question. Of this time, two hours and eight flights had been flown as pilot in command after acquisition of the type rating.

The pilot had undergone his helicopter flight training on the HU 269. He had not flown between completion of his flight training in July 2007 and conversion to the Exec 162F at the end of September 2008.

Aircraft Information

The Exec 162F is a kit-built helicopter manufactured by Rotorway. It is a two-seat helicopter with a semi-rigid two-blade rotor system that rotates clockwise. The helicopter is powered by a vertically installed 150 hp water-cooled four-cylinder horizontally opposed Rotorway RI 162F engine with electronic controls (FADEC -- Fully Automated Digital Electronic Control). In lieu of a main reduction gearbox and drive shafts, the Exec 162F employs a system of belts and chains. The maximum gross weight is 680 kg. In order to ensure the correct centre of gravity when flying with one or two persons on board, a trim weight is fixed either to the right front landing skid or under the tail boom. In the Exec 162F, an engine failure or a loss in main rotor speed is followed by a brief climb or nose pitch-up attitude.

The accident helicopter had been assembled by the pilot over a period of several years, and was first registered by the Netherlands Civil Aviation Authority on 13.03.2006. The Certificate of Airworthiness (C of A) was issued on 21.02.2007 but operation was limited to the Amsterdam Flight Information Region (FIR). The kit number bore the manufacturer's serial number 6808. At the time of the accident, the helicopter had flown a total of about 17 hours, including ground test running.

According a statement of the flight instructor of the R44 the pilot of the Exec 162 mentioned before the flight that his helicopter produces some vibrations above 80 kt. The pilot tried to solve this problem but did not succeed.

Meteorological Information

On the day of the accident, the routine weather reports (METARs) for Rheine-Bentlage and Münster/Osnabrück aerodromes and the report from the Nordhorn aerodrome flight information service officer, reported that on the day in question, surface visibility was better than 10 km, with four oktas cloud; the wind was westerly at 5 to 10 kt, the QNH 1 024 hPa and surface temperature about 10 °C.

Communications

Radio communications with the Nordhorn Tower and between the helicopters was not recorded.

Aerodrome Information

Nordhorn-Lingen (EDWN) aerodrome has a 900 m asphalt runway oriented 06/24 and is 87 ft above MSL.

Flight Recorders

The helicopter was not equipped with flight recorders, nor was there any current legal requirement for them to be fitted.

A video camera was carried on board the Robinson R44 from which a number of recordings were made. The images were made available to the BFU for evaluation (see appendix).

The engine had two electronic (FADEC) control units that store engine parameters for up to four hours. These two control units were made available to the BFU in fire-damaged condition, but the memory chip records had been destroyed by heat and could not be evaluated.

Wreckage and Impact Information

The accident site was about 4.2 km southwest of Nordhorn-Lingen aerodrome. The wreckage was found on the southern edge of a field from which potatoes had been harvested. Parts of the tail boom and cockpit glazing were found scattered along a 220 m stretch of ground leading to the main wreck.

The main wreck was found resting on its right hand side. The main rotor was transverse to and underneath the main wreck. One rotor blade was found with reddish paint residues towards the tip along the leading edge. The other rotor blade had lost a piece of skin about 10 x 10 cm from the upper surface. The rotor head had separated from the rotor mast, the central pivoting bolt bearing shells were broken. The left skid had been torn off together with the front section of the landing gear crossbar and was found in front of the main wreck in a ditch. The tip and heel were missing from the right skid. The skid tip with the trim weight for solo flight was found buried upright about 1 m deep in the ground about 25 m west of the main wreck. All the fuselage plastic fairings and most of the instruments had burned out. The engine had been torn from its frame and the induction manifold and the fuel control unit had melted. Drive belts in the vicinity of the engine had burned away. The control system was broken at a number of places between the cyclic stick, collective stick and swashplate. The push-pull cable to the tail rotor adjustment was connected in the vicinity of the cockpit, but separated in the vicinity of the tail rotor. The tail boom had separated close to the horizontal stabilizer. Two pairs tail rotor drive belt pulleys, two drive belts, an intact drive belt and a broken drive belt were found in the tail boom.



General view of the burned out helicopter

Photo: BFU

Wreckage from the tail boom, horizontal fin with winglets, cabin glazing and both doors were found on the field. The missing orange-coloured skin from one of the rotor blades was found about 190 m from the main wreck, while the separated tail boom and tail rotor were found about 74 m from the main wreck. Orange paint residues were found at the tail boom separation point, also at the break point on the tail rotor drive belt.



Separated tail boom with tail rotor and drive belt

Photo: BFU

Examination of the engine provided no indication of a mechanical malfunction. The spark plug condition was normal.

Medical and Pathological Information

A post-mortem examination of the pilot provided no indication of a health problem occurring during the flight.

Medical tests were made to determine the possible presence of blood alcohol, misuse of drugs and the effects of carbon monoxide, all with negative results.

Fire

The helicopter caught fire on impact, which was extinguished by the fire service.

Survival Aspects

Given the high impact energy and subsequent outbreak of fire, survival was not possible.

Organisational and Management Information

In the Netherlands the fabrication or assembly of homebuilt aircraft is governed by the national 'Homebuilt Aircraft Regulations'. Construction of homebuilt aircraft is monitored and supervised by the NVAV (*Nederlandse Vereniging van Amateur Vliegtuigbouwers*).

The pilot had formed the intention of marketing Exec 162F helicopter kits to customers in the Netherlands and providing builder support. The formation flight on the day of the accident was primarily for the purpose of obtaining air-to-air photographs of the helicopter.

In addition to the possession of a Private helicopter Pilot's Licence, operation of the Exec 162F required a type rating training course and a type rating practical test. As there was no qualified type rating instructor or type rating examiner in the Netherlands for the Exec 162F, the pilot underwent type training in Great Britain. This training was recognised by the Netherlands Civil Aviation Authority, which issued the Type Rating.

Additional Information

One of the special features of helicopters with a semi-rigid two-blade rotor system is that during flight manoeuvres that unload and/or produce negative deceleration, or if the main rotor speed becomes extremely low, it is possible for the main rotor to impact with the tail boom and/or cabin.

The Institute of Safety and System Management (SSM of University of Southern California) has made a study of helicopter accidents resulting from break-up in the air (*'Notes on causes of helicopter in-flight break-ups, May 1985'*). The study identified and summarised the causes.

The causes include pilot-error e.g.:

- Pilot-induced flight attitudes that unloaded the main rotor or resulted in negative acceleration
- Excessive angle of bank in flight
- Exceeding the maximum speed allowed, followed by stall of the receding main rotor blade
- Very fast control inputs

The study further identified a number of technical faults e.g.:

- Damage to or interruption of the control system
- Damage to the main rotor bearing and/or main rotor mast
- Damage to one or all of the main rotor blades

Other causes included, e.g.:

- Erroneous response in emergency situation
- Flight into strong turbulence
- Loss of a main rotor blade

There have been a number of past accidents to the Exec 90 and Exec162 helicopter in Great Britain and America arising from impact of the main rotor with the tail boom. In several instances the cause was not determined or there was suspicion of pilot error. In one instance, detachment of rotor blade skin was identified as the technical cause.

The radio fitted to the Exec 162F was installed in the centre of the instrument panel to the right of the pilot, who sits on the left. In order to change frequency, the pilot had to release the cyclic stick with his right hand to reach the frequency change button on the transceiver.

When starting an autorotation manoeuvre or in the event of an engine failure, in contrast to the Exec 162F, the HU 269 on which the pilot trained tends to pitch nose down.

Analysis

The pilot had acquired his Private Helicopter Pilot's Licence within the minimum number of hours prescribed by law on a helicopter with a three-blade main rotor. He had not flown in the period between passing his General Flying Test and the Type Rating training for the Exec 162F. He had both very limited overall flying experience and very little time on type. It was not possible to determine whether he was aware of the possible dangers associated with erroneous control inputs on a helicopter with a two-blade rotor system. It is highly probable that the pilot's very limited experience and being at the controls of a new type – particularly in view of the fact that the helicopter in question was a homebuilt helicopter still in the test phase – resulted in a very high workload for the pilot. The intended formation flight was an additional workload factor for an inexperienced pilot, in addition to which the handling pilot in the preceding helicopter was a student pilot.

The homebuilt helicopter was assembled from a kit and certificated with restrictions and limitations; given the fact that it had only flown for a very short time, the helicopter was still under test. However, the helicopter was substantially destroyed by fire, making it impossible to say with any certainty whether there had been a technical fault. Inspection of the engine wreck found no indication of an engine fault.

The helicopter weight and balance were very probably within the permitted limits.

On the day of the accident the weather was suitable for the intended flight and had no influence upon events. The wind speed was low at 5 to 10 kt, and no reports were received of possible turbulence.

The film images taken from the preceding R44 helicopter confirm the flying instructor's statement. The Exec 162F was to the left, behind and below the R44. The Exec 162F climbed from this position and disappeared from the field of view above and behind the R44. Given the background to these images, it was possible to reconstruct the position of the helicopter and its manoeuvre at this point.

It was not possible to establish what happened to the Exec 162F after it disappeared from the field of view behind the R44. It was not subsequently possible to identify either helicopter from the recorded radar trace.

In the past there have been several accidents to the Exec 162F arising from the two-blade rotor system, especially in the USA. In several instances the main rotor impacted with the tail boom.

Likewise, in this instance the main rotor impacted with the tail boom and separated it from the forward section during flight. This is demonstrated by the fact that the tail boom was found away from the main wreck, that coloured paint residues were found on the tail boom, the tail rotor drive belt, and on one rotor blade. Given the distribution of the wreckage and the trim weight buried deeply in the ground, the impact between rotor blade and tail boom must have taken place at cruise altitude.

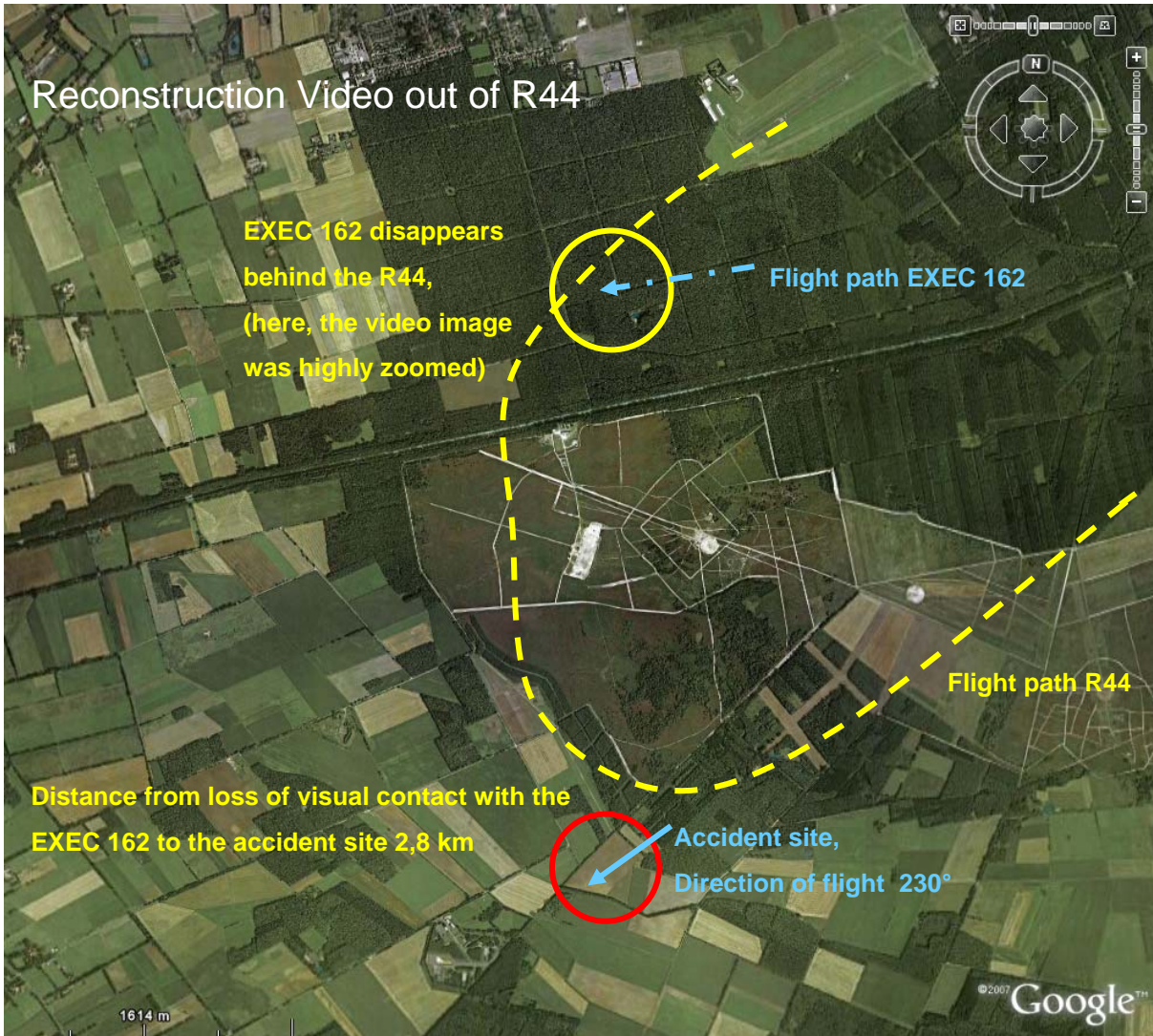
It could not be determined whether the pilot made erroneous control inputs, whether there was a technical failure, or whether there was some other cause such as an emergency.

Conclusions

The helicopter suffered an in-flight break-up caused by the main rotor impacting the tail boom. It was not possible to determine the underlying cause triggering the accident.

Investigator in charge: Rokohl
Assisted by: Lampert
On-site investigation: Karge, Rokohl
Braunschweig den: 22. September 2010

Appendices



Flight track, reconstructed from video film

Source: Google / BFU

This investigation was conducted in accordance with the Federal German Law Relating to the Investigation into Accidents and Incidents Associated with the Operation of Civil Aircraft (Flugunfall-Untersuchungs-Gesetz - FIUUG) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

The present document is a translation of the German Investigation Report. Although every effort was for the translation to be as accurate as possible, discrepancies may occur. In this case, the German version is the authentic report.

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