

# Investigation Report

## Identification

Type of Occurrence:	Accident
Date:	19 June 2009
Location:	Mannheim
Aircraft:	Helicopter
Manufacturer / Model:	Eurocopter France / EC 120B
Injuries to Persons:	Three persons slightly injured
Damage:	Aircraft substantially damaged
Other Damage:	Crop damage
Source of Information:	Investigation by BFU
State File Number:	BFU 3X078-09

## Factual Information

### History of the Flight

Within the scope of a commercial helicopter pilot's course the crew, consisting of a flight instructor, a student in the front and a second student seated in the rear, flew in a type EC 120B helicopter from Koblenz Special Airfield to Mannheim Special Airfield. The cross-country training flight was to end with a training autorotation initiated in the circuit downwind leg, with a 180° turn to the left.

The crew subsequently stated that the student pilot sitting front right had initiated the autorotation when the helicopter was downwind right south abeam Runway 27 at about 2,000 ft AMSL. After the helicopter was stabilised in the descent, the flight instructor in the left seat turned the twist grip power control on the collective lever

(Pitch) to 'IDLE'. After completing the left turn towards the special airfield at about 600 ft AMSL, the student pilot realised that the helicopter was too low and would be unable to reach the airfield and announced a 'go-around'. In response, the flight instructor returned the power lever twist grip to 'FLIGHT' so that the engine would resume power to the main rotor. At this moment, the crew observed a rotor over-speed warning, in response to which the pitch lever was pulled to return the rotor speed to the normal range. This was immediately followed by rotor under-speed and the crew noted that the engine was not delivering the anticipated necessary power. The flight instructor assumed control and at about 200 ft AGL initiated a steep turn to the left through about 100° and a flare to arrest the helicopter's descent. He stated that immediately prior to touchdown during pitch application there was a big concussion and a loud bang in the helicopter.

The helicopter made a hard landing at 1211 hrs<sup>1</sup> without any forward speed short of Runway 27 in a field of maize. The helicopter landing skids broke away from the rear cross-tube. The main rotor had cut through the tail boom. The Emergency Locator Transmitter (ELT) was activated. The signal was first detected at 1211:33 hrs.

The crew members were slightly injured but abandoned the aircraft unaided through the left door.

## Personnel Information

The 52 year-old flight instructor occupying the left seat was in possession of a Commercial Helicopter Pilot's Licence (CHPL) according JAR-FCL 2, valid to 04 December 2009. His licence incorporated Type Ratings as pilot in command for the EC 120 and HU 269 helicopters and as type rating instructor for the HU 269. Further, he held a flight instructor rating for both private and commercial helicopter pilots. He was in possession of a Class 1 medical certificate issued in accordance with JAR-FCL 3 with specified limitations, valid to 03 November 2009.

His total flight time was 4,641 hours, of which 13 hours were flown on the type in question including type conversion and the accident flight. He was a freelance pilot for the helicopter operator.

The 25 year-old student pilot was in possession of a Private Helicopter Pilot's Licence (PHPL) valid to 13 October 2013. His licence included a type rating as pilot in command for the EC 120 and HU 269 helicopters. He was in possession of a Class 1

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<sup>1</sup> All times local, unless otherwise stated

medical certificate issued in accordance with JAR-FCL 3 without limitations and valid to 12 March 2010. His total flight time was 113 hours, of which 23 were on the type in question.

The 39 year-old student pilot seated in the rear as a passenger was in possession of a Private Helicopter Pilot's Licence (PHPL) valid to 13 October 2013. His licence included type ratings as pilot in command for the EC 120 and HU 269 helicopters. He was in possession of a Class 1 medical certificate issued in accordance with JAR-FCL 3 without limitations and valid to 12 March 2010.

## Aircraft Information

The EC 120B is a light multi-purpose helicopter for up to five persons manufactured by Eurocopter France. The helicopter has a single main rotor with three blades, an anti-torque fenestron tail rotor, and a skid landing gear.

The helicopter's engine is monitored by a 'Vehicle and Engine Multifunction Display' (VEMD). Upwards of 60% N1 engine speed, the display changes the indications on three conventional analogue instruments (T4, TRQ, NG) to a round First Limit Indicator (FLI) instrument.

In case of an engine failure, be caution lights and warning tones will be triggered: a red oil-pressure-caution light "ENG P" with an acoustic gong, a yellow generator-caution light "GENE" and below 370 rpm main rotor speed there will be a low-rotor-rpm warning tone.

The accident helicopter was manufactured in 2002 Serial Number 1320 and equipped with an Arrius 2F gas turbine engine manufactured by Turbomeca. The maximum take-off weight was 1,715 kg; the weight at the time of the accident was about 1,427 kg. The last maintenance inspection took place on 12 June 2009 at 1,023 operating hours. The helicopter had a total operating flight time of 1,048 hours.

During previous training flights of student pilots the helicopter in question had already suffered a few unintentional engine shutdowns. These occurred during hover autorotation trainings and once during pedal-off training.

The Aircraft Maintenance Manual EC 120B, 80-11-00 Chapter 5-1 "Functional Test-Engine Starting Control" requires the check of the twist grip and correct operation of the lock-pin-mechanism: [...] 6. *After some seconds, make sure that the electromag-*

*netic locking pin locks the twistgrip: you cannot move the grip back to the "Off" position. [...]*

## Meteorological Information

At the time of the accident the Meteorological Aerodrome Routine Report (METAR) issued for Mannheim City Special Airfield gave: visibility in excess of 10 km; wind 270 to 330 degrees at 8 kt; scattered clouds (SCT) at 2,800 ft GND; temperature 20°C; dew point 12°C; barometric air pressure (QNH) 1,018 hPa.

## Communications

Communications between Mannheim-City Special Airfield tower and the helicopter were recorded and available for evaluation.

## Aerodrome Information

Mannheim-City Special Airfield is located southeast of Mannheim. The field elevation is 309 ft AMSL. In addition to two grass runways, it has an asphalt main runway 1,066 m x 25 m oriented 273° (093°). The special airfield is limited to the southwest and east by multi-lane roads. Both ends of the runway terminate close to earthen walls.

## Flight Recorders

The helicopter VEMD records operating times, engine start-up cycles, fault reports, any threshold values exceeded and performance data during engine checks.

The helicopter flight track was recorded by air traffic control radar.

The helicopter's on-board satellite navigation system (GPS) was not in operation at the time of the accident.

## Wreckage and Impact Information

The accident site was 250 m east of Mannheim-City Special Airfield's asphalt Runway 27 in a field of maize at about 309 ft AMSL. The helicopter fuselage rested on its belly oriented at 170°. The skids had broken off from the aft cross-tube and were directed upwards. The cross-tubes were twisted rearwards. The tail boom had sepa-

rated just in front of the vertical fenestron fin. The three main rotor blades were all damaged to varying degrees. One rotor blade had torn off and lay directly alongside the wreck. Parts of the tail boom and the fenestron drive shaft were found 44 m east of the wreck. The twist-grip power control on the collective lever was found in the 'FLIGHT' position.

There were 124 kg fuel remaining on board. No fuel was found to have leaked at the accident site. The fuel filters were filled with fuel and clean. The oil level in the main gearbox was within the correct range. The oil level in the fenestron gear could not be ascertained. However, lubricant residues were found outside the gearbox housing and on the ground.

The engine and control settings were inspected by a representative of the engine manufacturer after the wreck had been recovered. There were no irregularities.

Inspection of the twist grip power control on the pitch determined that it was possible to rotate it from 'FLIGHT' to 'IDLE' using normal strength, but without releasing the electric catch, the twist grip could be moved by force from the 'IDLE' position to 'OFF'. Eurocopter France conducted tests to determine the strength needed and the results showed that it was 10-times higher than to rotate the twist grip from 'FLIGHT' to 'IDLE'.

## Medical and Pathological Information

There was no indication of any adverse physiological or health influence on the flight crew. All three occupants were breath-tested for alcohol with negative results.

## Fire

There was no fire.

## Tests and Research

During the investigation, the accident flight was replicated with a Federal Police helicopter of the same type with a BFU observer on board. The objective was to observe the main rotor speed changes during autorotation flown in a turn and whether, during the recovery from autorotation with power recovery, there were any differences or unusual occurrences in comparison with other helicopters of this size as detected by the pilots. In addition, the replication was once repeated with the engine shut down to

determine whether there is any perceptible acoustic difference between the engine shut down and the engine at idle power setting.

The three pilots taking part in the replication flight described the autorotation characteristics as comparable with those of other helicopters. However, the increase in engine power at the end of the autorotation called for finely controlled coordination between operation of the twist grip power lever and pulling the pitch lever, to prevent the main rotor over-speeding. However, with practice the power recovery seemed to pose no problem.

When examining the sounds emitted by the helicopter during autorotation, the three pilots could detect no difference between engine operation at idle power or switched off.

The right collective lever which contained the stop-pin mechanism was disassembled from the wreck. Further investigation was conducted with the support of technicians from the Federal Police and later of Eurocopter Deutschland and still later examined at the facility of Eurocopter France.

The examinations revealed no technical reasons or deviation from the documentation that could explain why this twist grip could be closed over the electric catch in the absence of electric power. The mechanism, the stop-pin adjustment and the spring force for the pin were in accordance with the guidelines of the manufacturer. After the removal of three spacer washers (together 0.3 mm) to adjust the stop-pin, the twist-grip would not close. Eurocopter advised that no other incidences were known in which the twist grip could be closed in the absence of electric power.

Due to this accident Eurocopter France intends to revise the specifications for the stop-pin adjustment. The change will be introduced as a Service Bulletin. Eurocopter France also intends to change the training procedure in the Flight Manual.

The VEMD was evaluated by Eurocopter France in the presence of a representative of the French Aircraft Accident Investigation Authority (BEA).

It was determined that the last recorded flight (number 1338) had not ended and lasted less than one minute. During the accident flight (number 1337) the fault report 'Out of range TRQ' was recorded. Engine parameters recorded at the same time determined the fault occurred when the main rotor speed was 80 rpm, after a flight lasting 47:33 minutes. No recording was made indicating that any limiting values had been exceeded during flights 1337 and 1338. The last recorded 'Engine Power Check' revealed no defects.

The manufacturer made a boroscope examination of the engine. No evidence of interior damage was found. The engine was then fitted to a test bench and run. The test covered the entire range of engine control parameters and speed characteristics. The manufacturer found no deviation from the reference value.

## Organizational and Management Information

The helicopter operator held an Air Operator Certificate including flying training (FTO) issued by the Luftfahrt-Bundesamt. The operator had a flight operation management, a quality management and a safety management system.

Student pilots and the business manager of the company's branch office at Dinkslaken / Schwarze Heide Airfield (EDLD) stated that prior to the accident the engine of the helicopter had already suffered several unintentional shut downs during training flights. As a consequence the twist grip was no longer rotated to 'IDLE' during autorotation trainings at the satellite station.

On request of the BFU the operator in Mannheim stated that in 2008 it was noticed during the twist grip check that it was possible to rotate the twist grip over the 'IDLE' position to 'OFF'. As a consequence the twist grip mechanism was checked by a maintenance organisation with the following findings: *no malfunction determined; mechanical play minimal without influence to the power setting*. In December 2008 the still existing problem with the twist grip was mentioned during an internal flight instructor meeting. At this time the company determined that autorotation trainings should be performed without rotating the twist grip to 'IDLE'.

The Operation Manual Part A, Chapter 02.02.00, describes the "system for issuing additional flight operation instructions and information". According to which any additional operating instructions or information should be made known to all crew members by posting them in the operation's office or by publishing flight operation instructions or working instructions.

The flight instructor involved acquired his type rating for the EC 120B after the incidents with the twist grip and after the company's internal flight instructor meeting. He stated he had no knowledge about any previous problems with this helicopter and any internal company instruction about autorotation trainings.

## Additional Information

Enquiries made of EC 120B operators in Germany drew the response that there had been a number of instances in which the engine had been inadvertently switched off during a practice autorotation. In each case, the suspicion was that when closing the twist grip, the slide had inadvertently operated the electric catch pressure switch, after which further closure of the twist grip reduced power and reached the 'OFF' position.

The chapter for emergency training procedures in the Flight Handbook (FM Supplement 9-6, Engine Failure Training Procedure, Page 9-6-2, Rev.2) requires a check whether the N1-rpm has about 67% after rotating the twist grip to 'IDLE'. A Note at the end of the procedure points out that autorotation with power-recovery should only be undertaken within gliding distance of a suitable landing site with enough space for autorotation with run-on landing.

## Analysis

The helicopter flight crew were in possession of the required licenses and ratings.

The flight instructor was qualified and had the necessary flight experience for the intended training flight. However, he had very little experience on the EC 120B helicopter. The helicopter pilot licensing requirements stated in JAR-FCL 2.310 (6) call for a minimum of 15 hours on the type used for training. However, JAR-FCL 2.310 (7) Para. 2 says that this requirement may be replaced by a practical examination conducted in accordance with Appendix 2 of JAR-FCL 2.320 C and E. The flight instructor had undergone and successfully passed such a test on the EC 120B.

The autorotation leading to the accident was the flight instructor's first autorotation as pilot in command following his type rating. Given his total flight time and experience as instructor on the HU269, it can be assumed that a training autorotation with an EC 120B did not pose great difficulty.

The two student helicopter pilots were taking part in a course for the issue of a commercial helicopter pilot's licence. Given the continual nature of the training course and their prior possession of a type rating on the EC 120B, they were familiar with autorotation, power recoveries and the helicopter's general characteristics.

The helicopter was correctly certificated and maintained. There was no technical fault or impediment in the flying control systems. The centre of gravity was within the specified limits and the weight was beneath the maximum permitted take-off weight.

The en route weather was good for the intended flight and had no influence upon events.

During the training autorotation the student pilot realised that the helicopter could not reach the airfield and decided to stretch or terminate the autorotation with the help of power. This is where the problems started, including under-speeding by the main rotor, causing the flight instructor to assume there had been an engine failure, assume control and fly the autorotation into a field. The statements made by those present with respect to the engine were contradictory. Based upon their statements, it is uncertain as to whether the engine was running, then engaged and resumed the delivery of power, or whether it was only delivering limited power. Also, the possibility cannot be excluded that the engine was inadvertently shut down by the twist-grip following initiation of the autorotation. When shutting down the engine, the VEMD display would change from the single-unit First-Limit-Indicator to three analogue instruments. And the NF display (N2 engine speed) on the twin engine-speed indicator would fall to zero. Several caution lights would illuminate and warning tones would sound. These indications were not observed by any of those on board the helicopter.

Subsequent evaluation of the VEMD found no evidence that any threshold limits had been exceeded; solely, a low rotor speed fault report at the end of the accident flight. If the engine had been delivering power at the end of the autorotation – when the flight instructor attempted to prevent a hard landing by rapidly pulling the pitch lever for the flare, and the main rotor hit the fuselage boom – it is highly probable the limiting values would have been exceeded and recorded.

Subsequent examination of the engine and the test bench run revealed no evidence of engine defects, mechanical damage to the engine or problems with the engine control system.

The replication flights undertaken following the accident showed that the EC 120B rotor speed characteristics and the relatively shallow glide angle are easy to control. However, termination of the autorotation by the introduction of power does require a degree of practice to avoid over-speeding and make a coordinated resumption of normal powered forward flight. These flights also showed that it is virtually impossible to tell by reference to sound alone whether the engine is at idle or has shut down.

It was not possible to determine whether the engine had possibly been inadvertently switched off using the twist-grip power lever. In the past, there had been a number of instances in which the twist grip electrical catch had been inadvertently released allowing the twist grip to close to 'IDLE' and shut the engine down. So far, this had not led to an accident, because on each occasion there had been suitable terrain for autorotation.

On the helicopter in question, contrary to the manufacturer's instructions, when not in receipt of electric current it was possible to turn the power twist grip from 'FLIGHT' to 'IDLE' and 'OFF' without releasing the catch. The investigation could not discover any technical reason. The stop-pin mechanism and setting were correct. Several comparable pitch levers showed no differences and operated in accordance with the manufacturer's requirements.

The problems with the twist grip of this helicopter were known within the company. Technical checks of the twist grip were arranged several times but neither solved the problem. The helicopter was still used despite the existing problem and contrary to the manufacturer's maintenance documentation. The company instruction to not rotate the twist grip to 'IDLE' during autorotation trainings contradicted the procedure in the Flight Manual and the flight instructor on board had no knowledge of it. In this case the company regulations about the issuing of flight operation instructions and information was not adhered to.

## Conclusions

The accident was caused by loss of power during a training autorotation. If the power loss was the result of a rotation of the twist grip past the idle-stop position followed by an inadvertent engine shutdown or the result of a short engine malfunction could not be determined with absolute certainty.

## Safety Recommendations

Actions of the manufacturer:

Until a Service Bulletin and a Flight Manual change can be published, Eurocopter France issued the "Information Notice" No.2261-I-76 for all operators of the helicopter EC 120B. It describes the possible problem with the twist grip and the visual and acoustic indications for pilots in case of an engine failure (see appendix).

Investigator in charge: Axel Rokohl  
Field Investigation: Uwe Reibel  
Braunschweig: 19. July 2011

## Appendices



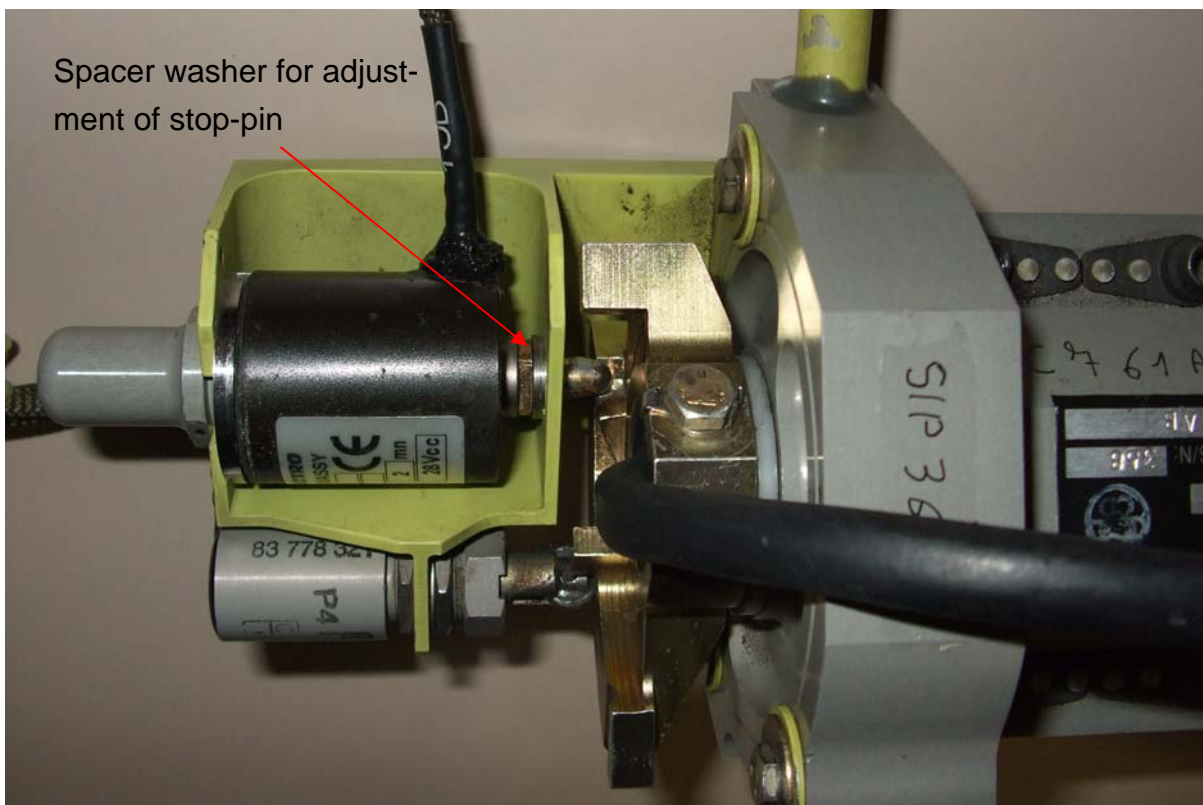
Air-to-ground view, accident site / airfield

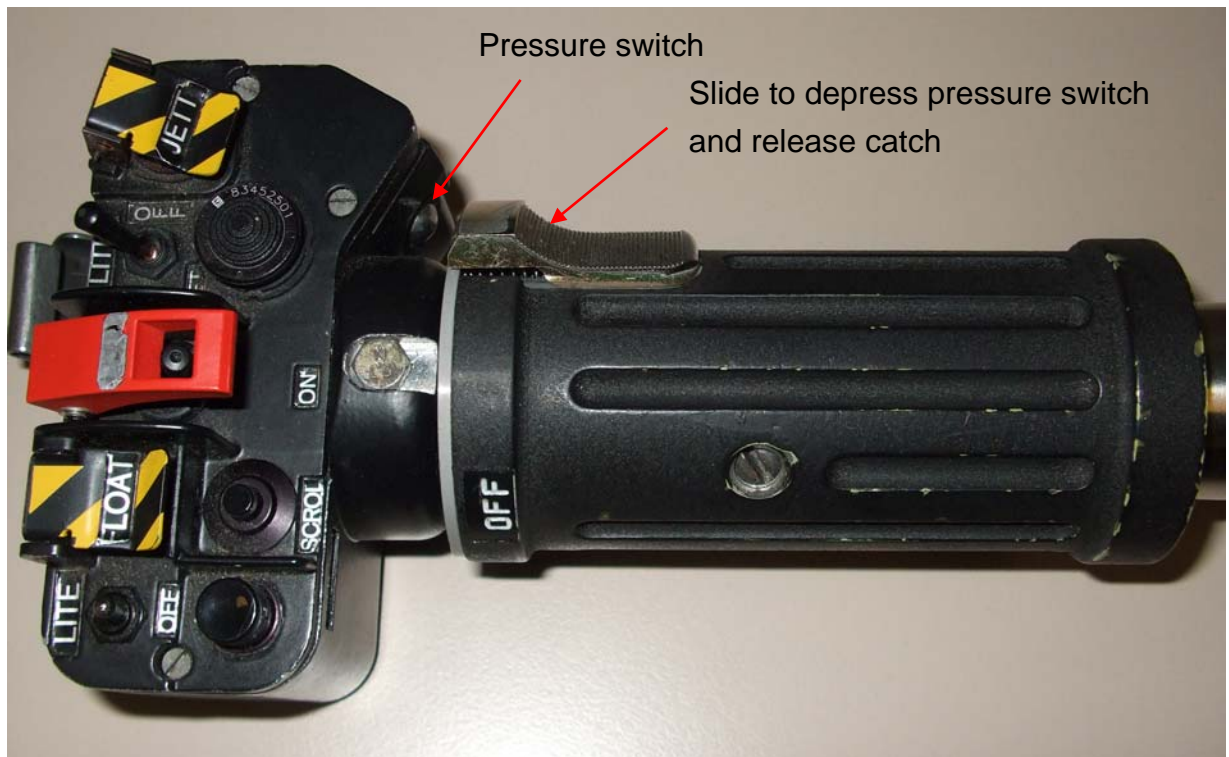
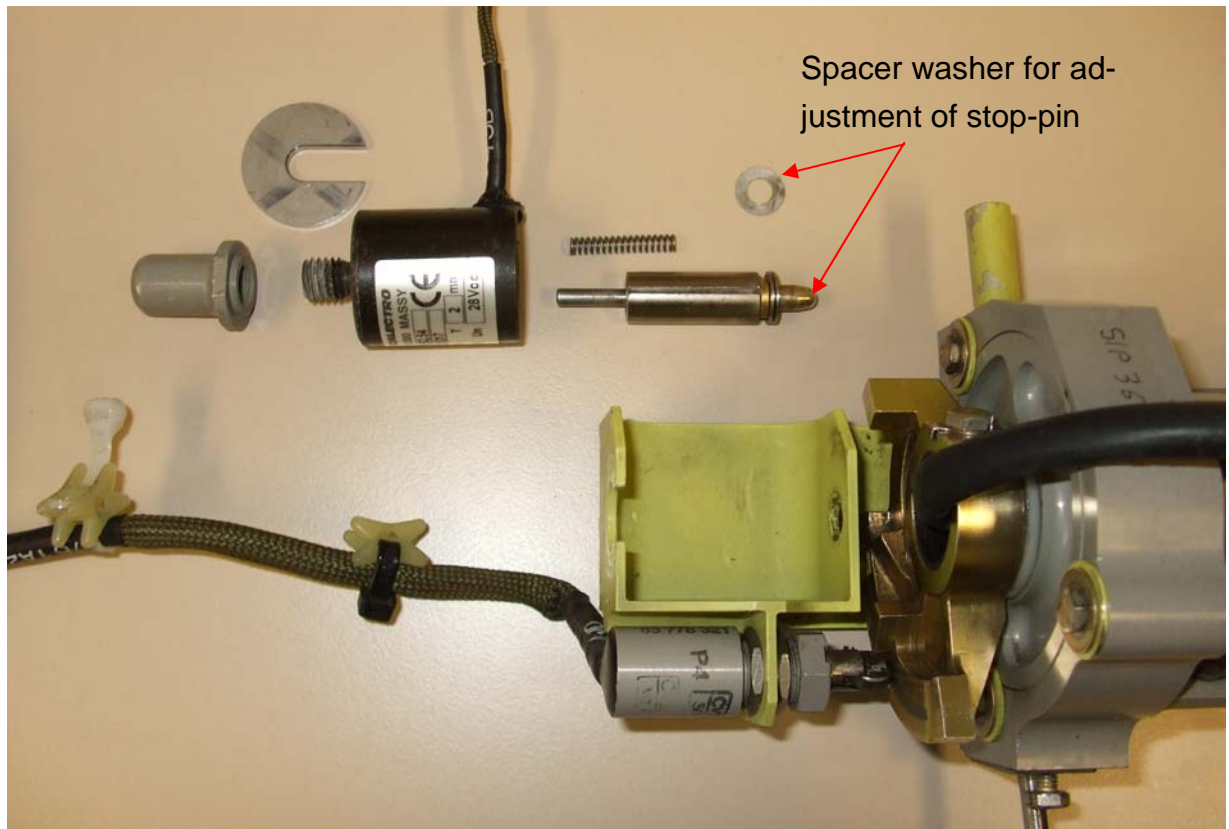
Photo: BFU



General view, main wreck

Photo: BFU





Detailed views of the twist grip electric catch



Photos (3): BFU


**No. 2261-I-76**

## Information Notice

### SUBJECT: ENGINE CONTROLS

**Twist grip - Reminders concerning the operation and setting of the "anti-flame-out" stop**

For the attention of	
	

AIRCRAFT CONCERNED	Version(s)	
	Civil	Military
EC120	B	

Investigations conducted on an EC120 helicopter revealed that, when forcing, the twist grip could be positioned from "flight" notch beyond the "idle" notch without any action on the starter button by the flight crew. This action, which may lead to an engine shutdown, was possible due to a lack of efficiency of the locking pin on the anti-flame-out stop.

EUROCOPTER reminds:

A - Maintenance crews:

1. That during functional tests following the setting of the starter control, as per AMM 80-11-00,5-1, it is required to ensure that the electro-mechanical locking pin prevents the twist grip from switching to the "shutdown" position without any pilot action on the starter button.
2. That the procedure described in AMM 76-12-00,4-5 enables to set the position of the locking finger.

B - Flight crews:

That in case of engine flame-out during engine failure training, the pilot is warned through the following information:

- NF decreases on the dual NF/NR indicator.
- NG decreases below 67% on the VEMD.
- The red "ENG P" warning light lights up on the caution advisory panel and the GONG sounds.
- The amber "GENE" caution light lights up on the caution advisory panel.

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 the translation of the German Investigation Report. Although efforts were made to translate it as accurate as possible, discrepancies may occur. In this case the German version is authentic.

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