

Investigation Report

Identification

Type of Occurrence:	Serious incident
Date:	16 March 2011
Location:	Near Augsburg
Aircraft:	Helicopter
Manufacturer / Model:	Eurocopter / AS 332 L1
Injuries to Persons:	None
Damage:	Minor damage to aircraft
Other Damage:	None
Information Source:	Investigation by BFU
State File Number:	BFU 7X004-11

Factual Information

History of the Flight

On the day of the occurrence a flight crew of three aboard an AS 332 L1 helicopter - two pilots and a flight engineer - flew several legs with landings in Friedrichshafen, Waldshut, Offenburg and Lahr. At about 1500 hrs¹ the crew took off in Oberschleißheim (EDNX) to fly to Friedrichshafen (EDNY). Passengers boarded the helicopter in Friedrichshafen and were

¹ All times local, unless otherwise stated.

flown to Waldshut and Offenburg (EDTO). Once the passengers had disembarked the helicopter was flown to Lahr (EDTL) for refuelling.

Then the return flight according to Instrument Flight Rules (IFR) was planned via Augsburg to Oberschleißheim. The helicopter took off at about 1958 hrs and climbed to Flight Level (FL) 70. The Cockpit Voice Recorder (CVR) recordings showed that in FL70 an outside air temperature of 0°C was read and therefore, the ice detector, the stabilizer de-icing and the cockpit window heating were switched on in addition to the already closed Multi Purpose Air Intakes (MPAI) (Anti-Ice „ON“). In the further course of the flight the outside air temperature in clouds was read with +3°C and later with +2°C. After about 20 minutes' flight time the flight engineer sitting in the cabin noticed precipitation in the light of the position lights and advised the crew accordingly. Due to the darkness, they could not recognise the precipitation. At that time, the ice-detector did not indicate any ice. After the helicopter was free of clouds increase in outside air temperature to +4°C was noted. The crew stated the co-pilot tried to check the MPAIs during the flight with a torch but it was not possible. No ice accretion was found on the mirrors for the inspection of the MPAIs. Because the weather had improved, the crew decided west of Augsburg to fly directly to Oberschleißheim without conducting an instrument approach to Augsburg. At about 2052 hrs the crew requested a descent to 5,000 ft AMSL. As the helicopter was about 15 Nautical Miles (NM) west of Augsburg, the crew began to switch off systems no longer needed like the ice detector, the stabilizer de-icing and the cockpit window heating. The crew stated that the outside air temperature was +9°C at that time. According to CVR recordings the copilot then wanted to execute a sand filter test because during initial engine start-up a malfunction occurred. He verbally announced the opening of the MPAIs for the test. The Pilot in Command (PIC) acknowledged it immediately with "Yes". The copilot answered "nothing can happen" and switched both MPAIs to Anti-Ice OFF, i.g. the MPAIS were opened. About five seconds later, at about 2058 hrs, both engines failed.

The CVR recordings showed that an autorotation was initiated and an emergency declared. During the autorotation the crew succeeded in re-starting the left engine after several tries. In an altitude of about 300 ft AGND the helicopter was flared and power-recovered. After the right engine was re-started the crew noticed unusual sounds and vibrations. Since the chip indication warning of the main gear box illuminated the crew suspected a transmission failure and intended to promptly land on a nearby lit up sports field. During the approach to the

sports field the main rotor RPM increased any time the pitch was pushed down. The crew then decided to fly to Augsburg Airport about five NM away.

During the search for the reason of the over-speeding main rotor the crew realised the engine control lever for engine No 1 (left engine) was pushed forward beyond the flight position and corrected it. Afterwards the main rotor RPM was once again controlled automatically and the helicopter could be landed in Augsburg.

Personnel Information

Pilot in Command (PIC)

The 41-year old pilot held a Commercial Helicopter Pilot's License (CPL(H)) issued according to JAR-FCL German valid until 18 August 2014. He had the ratings as PIC for AS332/EC225 and EC135P/135T. He was licensed for flights according to instrument flight rules.

His Class 1 Medical Certificate was valid to 04/02/2012.

He had a total of about 3,653 hours flying experience; about 203 hours of which were flown since May 2009 on the AS 332 L1; about 248 hours on the SA 330 and about 13 hours in the AS 332 flight simulator. The last proficiency check took place on 4 May 2010. In June 2010 he completed a 4-day AS 332 simulator training. All helicopters used in the type training in 2009, the simulator cockpit and the helicopter used for the last proficiency check were equipped with electrical heating mats for the anti-ice function.

In 2006 he completed the Multi Crew Cooperation (MCC) training. Since 1997, he has been flying for air rescue services on BO105 and EC135. According to his statement his experience regarding icing in flight was low.

Co-pilot

The 44-year old co-pilot held a Commercial Helicopter Pilot's License (CPL(H)) issued according to JAR-FCL German valid until 6 January 2015. He had the ratings as PIC for AS332/EC225 and EC135P/135T. He was licensed for flights according to instrument flight rules.

His Class 1 Medical Certificate was valid to 17/10/2011.

He had a total of about 3,306 hours flying experience; about 88 hours of which were flown since May 2010 on the AS 332 L1 and about 6 hours in the AS 332 flight simulator. Out of the seven helicopters used for type training two had MPAs for the anti-ice function. The type

rating check flight and the check flight for the instrument rating were conducted on helicopters equipped with electrical heating mats.

In 2010 he completed the Multi Crew Cooperation (MCC) training. Since 1991, he has been flying for air rescue services on BO105 and EC135. According to his statement he only had experienced ice accretion during a flight two to three times.

Flight mechanic

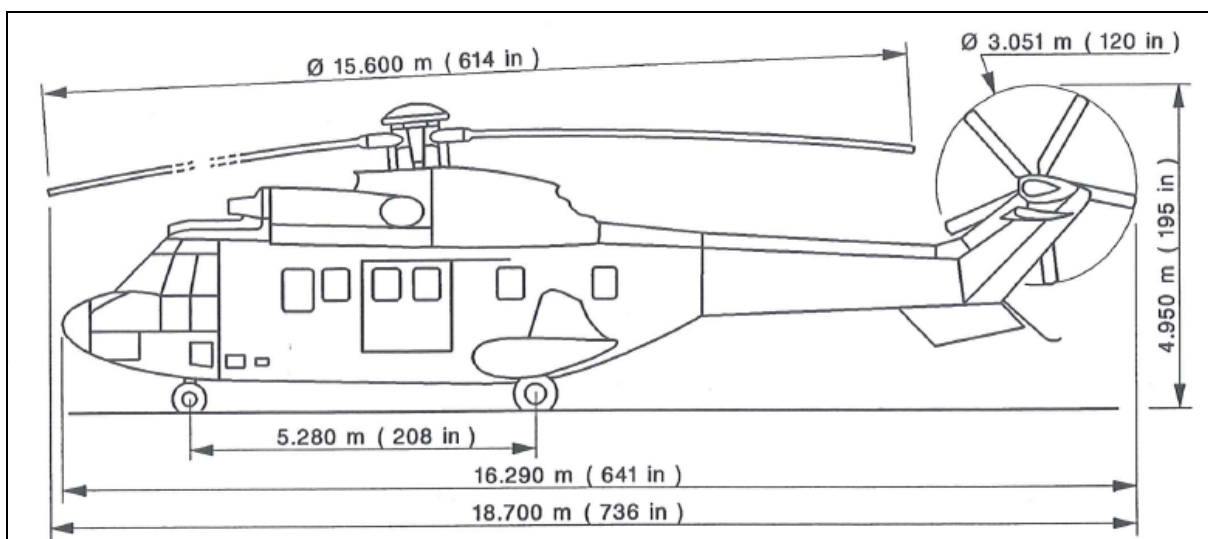
The 55-year old flight engineer held a flight mechanic license for helicopters. He held the ratings for servicing the AS332/EC225 and EC155.

His Class 1 Medical Certificate was valid to 08/03/2012.

He had a total of about 3,004 hours flying experience; about 50 hours of which on the AS 332 L1; about 380 hours on the SA 330 and about 5 hours in the AS-332 flight simulator.

Aircraft Information

The twin-engine helicopter AS 332 L1 manufactured by Eurocopter is a multi-purpose helicopter for up to 27 occupants. This model succeeded the SA 330. It was equipped with two Turbomeca Makila 1A1 engines, a four-blade main rotor and a retractable wheel landing gear. Maximum take-off mass is 8,600 kg. The helicopter was certified in 1985 according to FAR 29 as Large Rotorcraft, Category A and B. The required minimum crew for instrument flight rules is two pilots and for visual flight rules one pilot and one other qualified crew member or a fully functional autopilot.



Side view helicopter AS 332 L1

Source: Eurocopter

The helicopter in question, year of manufacture 2010, manufacturer's serial number 2774, had a certificate of registration issued by the Luftfahrt-Bundesamt (German civil aviation authority, LBA). The empty weight was 5,277 kg. The initial Airworthiness Review Certificate (ARC) was issued on 24 January 2011. At the time of the accident, the helicopter had a total of about 25 operating hours.

The helicopter was certified for flights in icing conditions. That is why its equipment included electrically controllable Multi Purpose Air Intakes in front of the engine inlets. These protect the engine from ice and snow or sand whenever they are closed (bullets travelled electronically into the forward position). The MPAs are controlled by two switches for the anti-ice and one for the sand filter function. These switches are located in the cockpit's overhead panel. If the MPAs are opened during flight after flying in icing conditions the flight manual stipulates the following procedure:

WARNING: AFTER A FLIGHT IN HAILSTONE, SNOW OR THROUGH AN ICING AREA, IT IS RECOMMENDED NOT TO OPEN THE BULLETS UNTIL THE FULL STOP OF THE ENGINES.

- However, should this be required, proceed as follows :
 - . Fly for a least 15 min at OAT well above freezing (not lower than +5°C).
 - . Check that there is no visible accretion of ice on the aircraft.
 - . Open one of the two air intakes.
 - . Open the other air intake five minutes after the first one, if the first engine has been operating properly during that period of time.

Excerpt from the flight manual, supplement 10.16.P1

Source: Eurocopter

The visual check if there is ice accretion is conducted with the help of two mirrors mounted to the cockpit roof. At night the check is conducted with the help of a torch.



Switch for the control and function indication of the MPAs



MPAIs closed and open, bullets in front or back



Mirror for the inspection of ice accretion on the closed MPAIs

Photos(5): BFU / Federal Police

According to the helicopter manufacturer, in the past there were no comparable double engine in-flight failures in connection with the handling of the MPAIs. However, customers did report engine damages after the MPAIs had been opened on the ground before shutting down the engines.

Closed MPAIs cause a slight reduction in available engine thrust (to calculate the available engine thrust the outside air temperature looked up in the table must be five degrees higher) and a fuel consumption which is about 3% higher.

According to the manufacturer's statements it is possible to equip the helicopter AS 332 L1 with a Flight Data Recorder (FDR) and is normally common based on the respective applicable certification regulation.

On 8 April 2011 due to the serious incident, the Bundespolizei (German federal police) arranged for an inspection of the temperature measuring equipment on five of

their AS 332 L1 helicopters. The inspection showed a discrepancy between the temperature indication on the instrument panel and the actual temperature of -0.3°C to $+3^{\circ}\text{C}$ and between the temperature values in the Aeronav GPS-System and the actual temperature of -1.3°C to $+1.4^{\circ}\text{C}$.

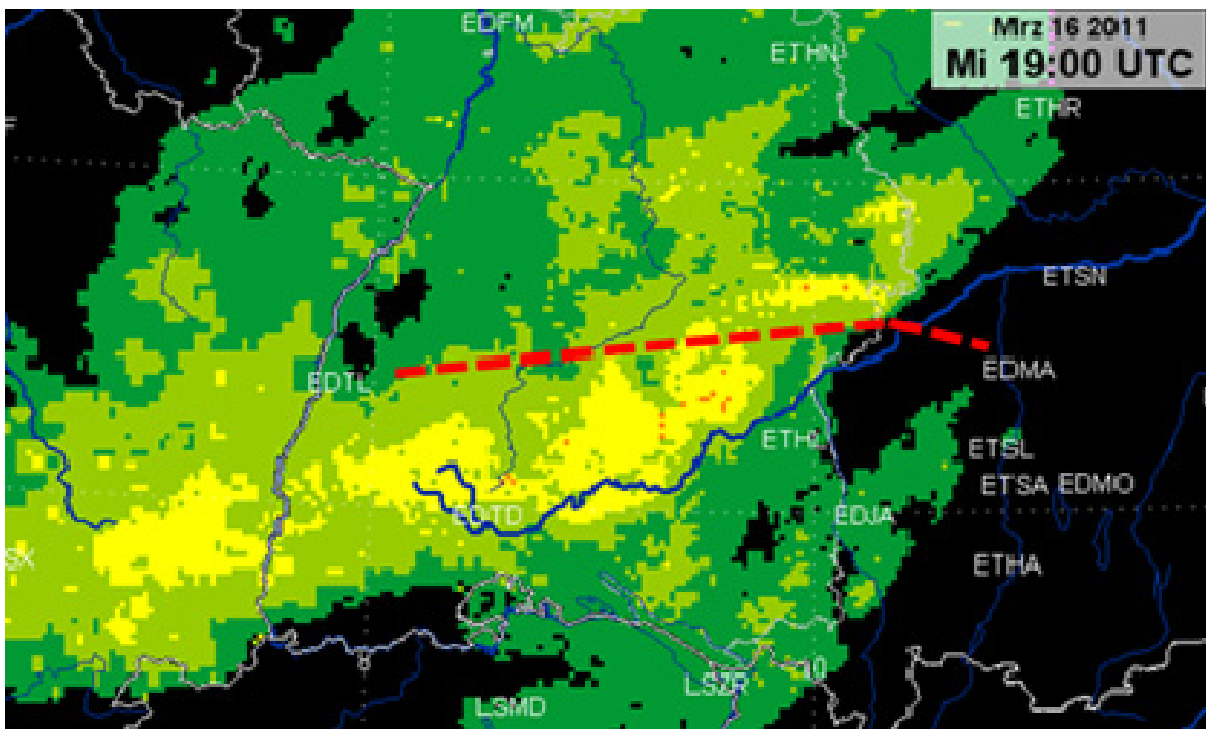
Meteorological Information

The BFU asked the Deutscher Wetterdienst (German meteorological service provider, DWD) for an official aviation weather report.

On the day of the occurrence, Germany was between a high pressure system above South Scandinavia and a low pressure system above the South of France. In some height a foehn current flowing south brought damp air. At Lake Constance a lee low pressure system had formed and during the night moved across Bavaria and the Czech Republic.

From the south clouds moved across Bavaria. The cloud base was at FL80 and the cloud top of the layer cloud was at about FL300. Isolated towering cumulus clouds (TCu) were embedded among the layers of cloud. The lower limit of the TCu was about 5,000 ft AMSL. In the foothills of the Alps it rained slightly. During the night stratus clouds formed in the foothills of the Alps and the cloud base sank.

A substantial rainfall area lay between Lahr and Ulm. In the area of the Alps the rainfall area showed moderate echo intensity. The precipitation rate was up to three litres per hour and square metre. This amount means moderate rain.



Precipitation radar recording with flight route drawn in

Source: DWD

The area forecast for low level flights (GAMET) predicted the freezing level in 8,000 ft AMSL. It must be assumed that in the area of the Alps it was lower due to the moderate rainfall. The temperature at the Klippeneck in 3,000 ft AMSL was 5.5°C. Extrapolated it resulted in a freezing level of almost 7,000 ft AMSL. The Feldberg in the south of the Black Forest reported a temperature of 3°C which resulted in a freezing level of 6,500 ft AMSL.

There was no significant meteorological information (SIGMETs).

The DWD expert came to the conclusion that ice accretion in FL70 between Lahr and Ulm cannot be excluded. The reason was in particular the freezing level at the time of the occurrence at the Klippeneck and the Feldberg.

Aids to Navigation

At the time of the occurrence the helicopter was guided by Munich Radar in direction of Maisach (MAH) DVOR/DME.

Communication

There were radio communications between the helicopter and Munich Radar and with ATC of Augsburg Airfield. The radio communications were recorded and made available to the BFU for this investigation.

Aerodrome information

Augsburg Airfield (EDMA) is located about 3.5 NM north-east of the Augsburg city limits with an aerodrome elevation of 1,515 ft AMSL. It has one tarmac runway with a length of 1,594 m oriented 251°/071°. For night operations the airfield is equipped with approach and runway lighting.

Flight Recorders

The aircraft was equipped with a L3Com FA 2100 Cockpit Voice Recorder (CVR). The CVR recordings were read-out and available for evaluation. The CVR recording showed that there was a friendly, quiet and work related atmosphere.

The helicopter was not equipped with a Flight Data Recorder (FDR). According to the Third Executive Order of the Regulation on Operation of Aircraft (Equipment and operation of aerial equipment outside an operator) para 27 (1) helicopters with a maximum take-off mass of more than 7,000 kg which were initially certified for registration after 1 January 1989 are to be equipped with a FDR. The LBA was of the opinion that the 3. Executive Order of the Regulation on Operation of Aircraft (LuftBO) was applicable for police aircraft.

On 11 April 2011, after the serious incident the LBA granted the Bundespolizei a special permit to operate the helicopter in question and the seven additional ones without an FDR until 31 March 2013.

The entire flight from the take-off in Lahr until the landing in Augsburg was recorded by radar. Only the end of the autorotation in about 2,400 ft radio altitude was interrupted for a short period of time.

Wreckage and Impact Information

When the BFU staff arrived the helicopter stood on the apron of Augsburg Airfield. The MPAs were closed. For further investigations the helicopter was brought into a hangar. With the support of technicians from the operator and the engine manufacturer, the engines, the air inlets, the magnetic chip detectors and the fuel and main gear box oil filters were examined. A metallic chip at the main gear box chip detector and damage on two compressor blades of the right engine were detected.



Damage on the compressor of the right engine

Source: Turbomeca

When the MPAIs and their control panel were checked the switches functioned as stipulated by the manufacturer. When the sand filter function was tested the left warning light for FAN-Fail illuminated even though the fan was running.

The tanks contained 490 and 530 litres of fuel, respectively. Fuel samples were taken from the tanks and filters. The examination of the fuel samples was conducted by the Bundeswehr Research Institute for Materials, Explosives, Fuels and Lubricants (WIWEB) in Erding. No indications for a causal connection with the engine failure were found.

Fire

There was no fire.

Organisations and their Procedures

General

The Bundespolizei is the largest operator of civilian registered helicopters in Germany. The air service encompassed five flying squadrons, 12 air rescue service centres and the joint flying training organisation for the federal and regional police.

The Bundespolizei mostly operates Eurocopter helicopters. There are single-engined training helicopters, twin-engined mission and rescue helicopters and large cargo helicopters. The helicopters are flown in single-pilot operation (pilot and flight engineer or HEMS crew member) or multiple-crew operation. The range of duty ranges from VFR flights during the day to IFR flights during the day or at night and mission flights at night with the help of night vision goggles. There are police mission flights, flights in the scope of disaster control and training flights. For the sporadic passenger transport flight and rescue missions they receive a reimbursement of costs.

The flight crews of the Bundespolizei are trained in Sankt Augustin at the joint flying training organisation for the federal and regional police according to the requirements of JAR-FCL2. The Flight Training Organisation (FTO) is certified by the LBA according to JAR-FCL2. The flying training organisation trains the basic training to acquire the CPL(H), further helicopter type ratings and other ratings, such as MCC, and other crew trainings.

Training

The Bundespolizei has compiled a three-page system description of the MPAs to be used for the orientation for the AS 332 L1 helicopter. This description contains images and key points describing the function of the MPAs. Page 3 contains the warning in German regarding the opening of the MPAs taken from the flight manual.

In addition, a flight operations information dated 26 August 2009 existed which contained the functionality of the MPAs and experiences gathered with them in arid environments. It stipulated that MPAs should only be opened after the engines were shut down because otherwise the sand gathered on the bullets could be sucked into the engines. This flight operations information also advised that the MPAs should only be opened after the engines were shut down when icing conditions had existed. If it is imperative that the MPAs be opened before the engines are shut down the requirements of the flight manual should be adhered to. This flight operations information was not known to the co-pilot since it had been distributed before he acquired his type rating.

Since 1995, the Bundespolizei trains their flight crews according to a Crew Coordination Concept (CCC). Since 2009 MCC trainings are conducted with the aim to train the correct cooperation and communication in the cockpit.

Flight Operations

The flight operations of the Bundespolizei were mainly regulated by flight operations instructions. On 1 July 2011, four months after the serious incident, a Flight Operations Manual (FOM) on the basis of JAR-OPS 3 was presented as a draft. Individual parts of the FOM were still being edited. On 1 April 2012 the Flight Operations Manual (FOM) was put into effect and the organisation "Aviation Organisation" established which was comparable to the flight operations organisation of an air operator.

In addition, a so-called Aircraft Operation Manual (AOM) for each helicopter type was to be prepared. In the trial version dated 25 January 2011 item 1.4, Aim stated: The AOM is a detailed working instruction for the flight crews on Bundespolizei helicopter. *[...] Operational procedures are divided and communications preassigned to ensure a standardised, efficient and safe work in the cockpit. With this the AOM implements the provisions of the CCC [...].*

Item 2.4.1, Switching of Systems: Every switching of systems which is not ordered by the Pilot Flying (PF) must be reported. *[...] The switching of systems by the PF is to be reduced to a minimum [...]. It is essential that the following switching of systems in flight is acknowledged by the PF: engine switches, engine fuel shut off valve, FADEC, activation of the fire extinguishing system, throttle, landing gear.*

Crew

The procedural instruction 09/06 "Flight time regulations for pilots and flight engineers of the Bundespolizei air service" regulated the recurrent training of the crews. This instruction arranged for at least one training every three calendar years per helicopter type flown for each crew member either in a synthetic training device or a flight simulator. The amount of flight time a crew member had to complete each year depended on the total flying experience and the number of type ratings. Annually a proficiency check for the extension of the type rating was to be conducted. As stated in the instruction dated 5 January 2011 there was no written exam during the proficiency check. This was substituted by a conversation between examiner and pilot with the aim to check the theoretical knowledge. The central question and topic changed annually.

The Bundespolizei stated that about 20% of the annual budget for flight operation is spent on practical training. In the years 2010 and 2011 all steadily available pilots with the type rating for the AS 332 L1 and IFR ratings had participated in simulator training.

As a rule, the helicopter AS 332 L1 was flown during the day under VFR with one pilot and one flight engineer. Only for special missions and IFR flights two pilots were deployed.

Regulations for Commercial Flight Operations

JAR OPS 3 Commercial Air Transportation (Helicopters) is the basis for the operation of civilian helicopters for commercial transport. JAR-OPS 3, Subpart N described the elements of a flight crew. JAR-OPS 3.940 ff, Composition of Flight Crew, described the minimum requirement to be a PIC of a multi-crew operation. JAR-OPS 3.943 Initial Operator's Crew Resource Management (CRM) training, described the training required for an effective work of the crew. JAR-OPS 3.965 Recurrent Training and Checking, described:

recurrent [...] (iv) Crew Resource Management (CRM) training - by suitably qualified personnel [...]

[...] (e) CRM. An operator shall ensure that: (1) Elements of CRM are integrated into all appropriate phases of the recurrent training, and; (2) Each flight crew member undergoes specific modular CRM training. All major topics of the initial CRM training shall be covered over a period not exceeding 3 years.

semi-annual [...] (i) Each flight crew member undergoes operator proficiency checks to demonstrate his competence in carrying out normal, abnormal and emergency procedures [...],

annually [...] (ii) Line checks – [by suitably qualified] commanders [trained in the assessment of CRM skills (see ACJ-2 OPS 3.943 paragraph 4)] nominated by the operator and acceptable to the Authority [...],

[...] (g) Helicopter/flight simulator training. An operator shall ensure that each flight crew member undergoes helicopter/flight simulator training at least every 12 calendar months.

According to JAR-OPS 3.001 these regulations did not apply [...] [(1)] *To helicopters when used in military, customs, police services [...].* REGULATION (EC) No 216/2008 on common rules in the field of civil aviation requires, however [...] The Member States shall undertake to ensure that such services have due regard as far as practicable to the objectives of this Regulation.

Helicopter Certificate of Registration

The Luftfahrt-Bundesamt (LBA) is responsible for the issuance of a certificate of registration in Germany. In the scope of the certification process it is checked whether all applicable national and international equipment regulations are adhered to. With used aircraft or aircraft imported from non-EU states LBA staff checks this even on-site if indicated. With new aircraft from an EU state this check is omitted. Based on the written statement of the manufacturer the LBA assumes that all national requirements are met. From the documentation provided for the certification process it cannot be discerned whether or not an aircraft is equipped with a Flight Data Recorder (FDR). On enquiry by the BFU the LBA pointed out that the owner is responsible for the adherence to operating instructions.

Additional Information

At the time of the Serious Incident, the Bundespolizei operated a total of 20 AS 332 L1 helicopters. The helicopters were equipped with different types of engine inlet cowl anti-ice. Five helicopters had MPAIs and 15 helicopters had electrical heating mats. The predecessor SA 330 helicopter was also equipped with MPAIs. The procedure for the disconnection of the anti-ice function differed according to the anti-ice protection used (Refer to Page 6, Excerpt from the Flight Manual).

FLYING WITH OAT LESS THAN +5°C

IF THE ENGINE AIR INTAKE SCREENS ARE EQUIPPED WITH THE OPTIONAL ELECTRIC ANTI-ICING SYSTEM, (ACCORDING TO VERSION) THE SYSTEM MUST BE SWITCHED ON WHEN FLYING IN CONDITIONS WHERE OAT IS LESS THAN +5°C, AND HUMIDITY IS VISIBLE (EVEN IF THERE IS NO OBVIOUS ICING).

- ENGINE 1 and ENGINE 2 switches - - - - - ON
- . Check corresponding amber lights remain OFF.

The system may be switched off, as soon as humidity is no longer visible or OAT is above +5°C.

REMINDER : Max. OAT for continuous operation = +10°C.

Excerpt from the flight manual, Disconnection of the heating mats

Source: Eurocopter

On 14 April 2011 Eurocopter published the Safety Information Notice No 2317-S-30 due to the serious incident. The safety information notice warns about possible engine failure or damage due to ice ingestion and once again emphatically advises of the adherence to the procedures described in the flight manual.

Analysis

A single engine failure does not result in an emergency with a helicopter with the flight performance class 1 when category A procedures are applied. A simultaneous double engine failure due to the same causes should be highly unlikely with a helicopter with flight performance class 1 (Certification Specifications for large rotorcraft 29.1309). A double engine failure is to be classified as serious incident since an accident could be avoided.

Crew

The flight crew members were licensed and qualified for the flight in accordance with existing regulations. Both pilots had a substantial total flying experience. In relation to the helicopter type their flying experience was comparatively low, however. The flight time was collected in a short time and, therefore, their practice level high. Both pilots had only sporadic experiences with icing in flight. In the last years, both pilots mainly flew in one-pilot operations (pilot and HEMS crew member) in air rescue service.

The analysis of the CVR recording showed that there was a friendly, quiet and work related atmosphere. The recording also showed that the basics for the cooperation in the cockpit were not always consequently applied and not all crew resources were requested and used. Both pilots expressed their actions but before carrying them out neither waited for the other to acknowledge them or demanded an acknowledgement. The BFU is of the opinion that this is a typical behaviour pattern for pilots with a large single-pilot flying experience. The MCC procedures require clear communication, standardised phraseology, two-way checks and acknowledgements. Actions of individuals shall be acknowledged, doubted or even prevented by other crew member's responses. Compared to single-pilot operation the crew's performance shall be improved through communication. The CVR recording showed that the crew was not aware of a possible ice accretion. The announcement of the copilot that he is going to open the MPAs was followed by an immediate "Yes" from the PIC. There was no visual inspection of the MPAs at that moment. The BFU doubts whether ice accretion can always be detected in the mirrors at night.

After the double engine failure the crew worked together constructively. The crew worked together on the emergency procedure in regard to the double engine failure, the autorotation, the engine re-starts in flight, the illumination of the main gear box chip indication and the suspected transmission failure.

Aircraft

The helicopter was properly registered and maintained except for the missing flight data recorder. It was as good as new and the 25-hour inspection was almost due. Mass and centre of gravity were within their prescribed limits. It is highly likely that the metallic chip found in the main gear box chip detector was grit which was produced after a new gear box had been put into service. It is likely that the damage found on the compressor blades of the right engine were caused by ice ingestion. The deformation corresponded with those found on engines which had failed due to ice ingestion.

The BFU is of the opinion that the procedure in the flight manual to open the MPAs again after a flight in icing conditions does not make sense. Due to unnoticed ice accretion, mostly in the dark, a single engine failure and a possible damage can occur even if the procedure is carried out correctly. The engine damages reported to the manufacturer which occurred on the ground argue for it. The BFU is of the opinion that the minimally reduced engine thrust and the fuel consumption increased by about 3% when the MPAs are closed can be neglected. As a rule, the increased fuel consumption is covered by the 5% or 10% contingency fuel.

Weather

The weather for the return flight to the home base did not restrict the planned IFR flight. There was a possibility of icing conditions above the Black Forest but it was not a limitation for the helicopter used. The DWD weather data and the crew's findings that the outside air temperature was 0°C to +4°C and that there was partial rainfall in FL70 showed it was highly likely icing conditions prevailed. The icing intensity was so low, however, that the crew did not receive any information about it via the instruments in the helicopter. Nor was ice accretion visible in the dark nor was there any change in the helicopter's performance parameter.

The damage on the engine and the engine failure shortly after the opening of the MPAs do not allow for any other conclusion but an ice accretion on the helicopter or the MPAs.

Organisational and Management Information

The Bundespolizei operated an AS 332 L1 helicopter fleet where the type of engine inlet cowl anti-ice was mixed. Whenever icing conditions are expected the respective system has to be switched on. The procedures differ considerably in regard to the

switching off of the anti-ice function. The electrical heating mats of both engines can be switched off simultaneously. At an outside air temperature of 10°C they have to be switched off. To open MPAs in flight, on the other hand, can only be an exception. The pilots involved in the serious incident flew during their training and the recurring simulator training and during check flights mainly with helicopters which were equipped with electrical heating mats. The BFU could not determine conclusively whether the pilots involved had knowledge about the different procedures and taken them in, especially since the experience with icing in flight with an AS 332L1 helicopter was very low or non-existent. The mixed fleet and the differing procedures may have contributed to the simultaneous shut off of the anti-ice systems of both engines.

During the investigation of the serious incident the qualification of the crew, the training and recurrent training were investigated. This showed that compared with civilian commercial flight crews the recurrent training of Bundespolizei crews were reduced. The number of recurring check flights and trainings is less compared with the requirements of JAR OPS 3.

Flight Recorders

The investigation determined that contrary to national and international equipment regulations the helicopter was not equipped with a FDR. An initial certificate of registration issued after 1989 requires for a helicopter of this size a CVR and a FDR. During the certification process the LBA should have recognised this. The investigation showed that the equipment of a new aircraft imported from an EU state will not be examined by LBA staff on site. The documentation provided for the certification process does not show the equipment either. This resulted in the fact that for the last several years the Bundespolizei unintentionally operated several helicopters which did not comply with equipment regulations. According to the LBA these equipment regulations were applicable.

The BFU recommends that the AS 332 L1 helicopters operated by the Bundespolizei which were certified before 1989 are also equipped with a FDR or at least with a simple data recording device. Due to the complexity of large helicopters it would pose a safety gain in case of a serious incident or accident if recorded data could be read out.

Conclusions

The double engine failure in flight was caused by the incorrect handling of the engine inlet cowl anti-ice.

Contributing factors:

- Weather conditions which resulted in unnoticed ice accretion
- Darkness, which made the recognition of ice accretion difficult
- The mixed fleet of helicopters in the Bundespolizei flight operations with differing procedures regarding the engine inlet cowl anti-ice
- A not consequently conducted communication of the crew members as is stipulated in the basics for the cooperation in the cockpit
- A procedure in the flight manual which allowed the opening of the MPAs during flight.

Safety Recommendation

Actions by the Bundespolizei

On 18 March 2011, due to the serious incident the Bundespolizei decided that all helicopters equipped with Multi Purpose Air Intakes are to be operated exclusively with closed MPAs.

The flight operations instruction dated 20 April 2011 cancelled the instruction of 18 March 2011 and referred to the procedures in the flight manual. In addition, it was instructed that after a flight either in suspected or real icing conditions the MPAs can only be opened on the ground after the engines have come to a complete stop.

The Bundespolizei conducted an investigation themselves into the occurrence including analysis. The conclusion of the 21-page report states recommendations concerning personnel, technology and organisation of the Bundespolizei flight operations.

The recommendations concerning the personnel referred to the regularly scheduled training and re-current training in regard to the handling of the various anti-ice protection systems, the re-start of an engine in flight and the consolidation of Call-Response procedures.

In regard to the technology the recommendations concerned the instrument panel for the anti-ice protections systems, the third seat in the cockpit for the additional crew member and the equipment of the helicopters with flight recorders.

In the area of organisation the recommendations concerned: the central preparation and distribution of flight safety information, changes in the flight manuals, etc. with proof that the addressee has received it; course management; the regulation situation regarding the start of the engine from the left seat; the annual conduct of orientations in regard to winter flight operations.

Actions by the Manufacturer

On 14 April 2011 Eurocopter published the Safety Information Notice No 2317-S-30 due to the serious incident. The safety information notice warns about possible engine failures or damage due to ice ingestion and once again emphatically advises of the adherence to the procedures described in the flight manual (See Appendix 1).

Safety Recommendation

21/2012: In the scope of the aircraft registration process the Luftfahrt-Bundesamt (LBA) should ensure that the equipment requirements, especially the installation of a Flight Data Recorder (FDR), are met.

22/2012: The Bundespolizei (German federal police) should equip their helicopters, type AS 332 L1, with an initial certificate of registration after 1 January 1989, with flight data recorders in accordance with the valid equipment requirements. The helicopters with an initial certificate of registration before 1989 should at least be equipped with a simple flight data recording device.

23/2012: The helicopter manufacturer, Eurocopter, should ensure, through a respective procedure change in the flight manual, that the Multi Purpose Air Intakes (MPAIs) are exclusively opened after the engines have been shut down on the ground if icing conditions had been encountered.

Investigator in charge: Axel Rokohl

Assistance: Thomas Kostrzewa, Hans-Werner Hempelmann

Braunschweig, 23 May 2012

Appendix:

Safety Information Notice by the helicopter manufacturer


No. 2317-S-30

SAFETY INFORMATION NOTICE

SUBJECT: ICE AND RAIN PROTECTION - POWER PLANT

Double engine flame-out due to ice ingestion

For the attention of



AIRCRAFT CONCERNED	Version(s)	
	Civil	Military
SA330		Ba, Ca, Ea, H, L, Jm, S1, Sm
EC225	LP	
EC725		AP
AS332	C, C1, L, L1, L2	B, B1, F1, M, M1
AS532		A2, U2, AC, AL, SC, UC, UE, UL

The feedback from experience gained on the helicopters equipped with the "Multi-Purpose Air Intake" (MPAI) protection system has revealed some cases of engine damage and/or flame-out which occurred in flight or at the end of the flight in icing conditions.

The latest case occurred following a flight in these conditions, when the bullets had been opened simultaneously and prematurely, causing a double engine flame-out in flight. The engines could be restarted only late and the aircraft landed as a precautionary measure.

The multi-purpose air intake protection system enables to perform flights in these icing conditions in full security, on the condition that the procedures described in the Flight Manual are complied with.

Although the turbo-shaft engine has a good snow or ice absorption capacity, an engine flame-out and/or damage to the axial compressor is possible in case of sudden ingestion of a sufficient quantity. This damage is generally limited, but it may affect the engine capacity for an immediate restart in case of flame-out in flight.

Consequently, if you encounter icing conditions in flight, we remind you that compliance with the procedures described in the adequate section of the Flight Manual, relating to the use of the multi-purpose air intakes, is mandatory, especially the precautions to be taken before opening a bullet.

These procedures indicate the flight conditions in which the bullets must be closed and it is strongly recommended not to open them again until the engines are fully shut down.

If a reopening is really necessary, the procedure to be complied with is described in the Flight Manual. It comprises:

- A minimum flight duration of 15 minutes in clearly positive temperature.
- The check for absence of visible ice deposit on the helicopter.
- The opening of one of the bullets.
- The opening of the second bullet 5 minutes later if the engine has been operating correctly during this period.



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The delayed reopening of the two bullets is a precaution to be taken regardless of the reasons for the bullet closing.

It is therefore also recommended not to reopen the bullets on the ground before the engines are fully shut down, in order to prevent any potential damage to the engines.

The photos below, which were taken on the ground when the engines were shut down, show examples of possible ice accumulation on the multi-purpose air intakes.



Safety Information Notice

Source: Eurocopter

The investigation has been conducted in compliance with the law relating to the Investigation of Accidents and Incidents associated with the Operation of Civil Aircraft (Flugunfall-Untersuchungsgesetz - FIUUG) dated 26 August 1998. According to the law the sole objective of the investigation shall be the prevention of future accidents and incidents. It is not the purpose of this activity to assign blame or liability or to establish claims.

Published by:

German Federal Bureau of
Aircraft Accident Investigation

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