Final Report AO-2017-001: Eurocopter AS350 BA, ZK-HKW, Collision with terrain,
Port Hills, Christchurch, 14 February 2017

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Final Report

Aviation inquiry AO-2017-001:
Eurocopter AS350 BA, ZK-HKW

Collision with terrain

Port Hills, Christchurch,
14 February 2017

Approved for publication: May 2018

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (Commission) is a standing commission of inquiry and an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector and the public, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

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Important notes

Nature of the final report

This final report has not been prepared for the purpose of supporting any criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 makes this final report inadmissible as evidence in any proceedings with the exception of a Coroner's inquest.

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Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1982 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams, pictures

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Verbal probability expressions

The expressions listed in the following table are used in this report to describe the degree of probability (or likelihood) that an event happened or a condition existed in support of a hypothesis.

Terminology (adopted from the Intergovernmental Panel on Climate Change)	Likelihood of the occurrence/outcome	Equivalent terms
Virtually certain	> 99% probability of occurrence	Almost certain
Very likely	> 90% probability	Highly likely, very probable
Likely	> 66% probability	Probable
About as likely as not	33% to 66% probability	More or less likely
Unlikely	< 33% probability	Improbable
Very unlikely	< 10% probability	Highly unlikely
Exceptionally unlikely	< 1% probability	

AS350 BA, ZK-HKW

(Courtesy of Way To Go Heliservices)

Source: mapsof.net

Location of accident

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Abbreviations

BEA	Bureau d'Enquêtes et d'Analyses (France)
CAA	Civil Aviation Authority
Commission	Transport Accident Investigation Commission
ELT	emergency locator transmitter

Glossary

dipping pond	a location for filling a monsoon bucket
Mayday	a distress message indicating a condition of being threatened by serious and/or imminent danger and of requiring immediate assistance
monsoon bucket	a large bucket, slung beneath a helicopter, for dropping water on a fire or other target
tetrahydrocannabinol	the principal psychoactive constituent of cannabis
wind shear	a change in wind speed and/or direction over a relatively short distance

Data summary

Aircraft particulars

Aircraft registration:	ZK-HKW
Type and serial number:	Eurocopter[1] AS350 BA, 1360
Number and type of engines:	one Honeywell LTS 101-600A-3A turbo-shaft
Year of manufacture:	1980
Operator:	Way To Go Heliservices Limited
Type of flight:	firefighting
Persons on board:	one
Pilot's licence:	commercial pilot licence (helicopter)
Pilot's age:	38
Pilot's total flying experience:	2,350 hours (approximately)

Date and time	14 February 2017, 1405[2]
Location	Port Hills, Christchurch
	latitude: 43° 36.4´ south
	longitude: 172° 39.5´ east
Injuries	one fatal
Damage	helicopter destroyed

[1] Eurocopter has been known as Airbus Helicopters since 2014.
[2] Times in this report are in New Zealand Daylight Time (co-ordinated universal time + 13 hours) and expressed in the 24-hour format.

1. Executive summary

1.1 On the afternoon of 13 February 2017, wildfires broke out on the Port Hills between Lyttelton Harbour and the south-eastern suburbs of Christchurch. A major effort began early the following day to control the fires, using large ground parties assisted by up to 12 helicopters and two aeroplanes. In the early afternoon one of the helicopters, a Eurocopter AS350 BA 'Squirrel' registered ZK-HKW, crashed while returning to the dipping pond to refill an underslung monsoon bucket. The pilot was fatally injured and the helicopter was destroyed.

1.2 The suspension line for the monsoon bucket had contacted the tail rotor. The damage to the tail rotor caused the vertical stabiliser to tear off the tail boom, and the helicopter became uncontrollable and crashed.

1.3 A video recording taken from a camera mounted underneath the helicopter showed the monsoon bucket rising towards the tail rotor. The video recording also showed that an object fell from the helicopter shortly beforehand. It is virtually certain that this was the window that had dislodged from the left rear sliding door. The pilot had experienced a similar loss of the left rear window while flying the same helicopter on a firefighting mission in 2015.

1.4 The Transport Accident Investigation Commission (Commission) found that the door configuration was prohibited in the flight manual, and therefore the helicopter was being flown outside the manufacturer's approved limits. It was very likely that the monsoon bucket flew up towards the tail rotor due to a combination of forward air speed and turbulence. At the same instant, the pilot's slowing of the helicopter in response to losing the window resulted in the tail rotor dipping and making contact with the rising suspension line for the monsoon bucket.

1.5 The hazard of an underslung load striking a tail rotor is a known risk to helicopter operations.

1.6 Although not directly contributing to the accident, the Commission found three deficiencies that indicated the helicopter operator's quality assurance system should be reviewed.

1.7 The Commission found that it was very unlikely that the pilot was impaired by his recent use of cannabis, but reiterates its view that the use of performance-impairing substances by pilots is a serious risk to aviation safety.

1.8 Two safety issues were identified in the inquiry:

- there may not be a good awareness within the helicopter industry of the additional risks involved with underslung load operations, particularly with the use of monsoon buckets during firefighting operations
- the operator did not have adequate systems available for the pilot to determine the actual all-up weight and balance of the helicopter for the firefighting operation, or to ensure that incidents such as the previous loss of a window were recorded, notified to the CAA and investigated.

1.9 The Commission has previously made recommendations to address the issue of substance impairment and to address industry awareness of the risks involved with underslung load operations. It made a new recommendation to address the operator's procedural safety issues.

1.10 The Commission identified the following key lessons as a result of its inquiry into this accident:

- flight in turbulent conditions requires care in order for the pilot to avoid exceeding an aircraft or equipment speed limitation
- it is important that operators and pilots understand the reasons for and observe the specific limitations applicable to each aircraft that they operate, as variations often exist between different variants of the same aircraft type
- all operational incidents should be recorded and investigated by the operator so that the causes can be identified and corrective or preventive actions taken

- performance-impairing substances such as recreational drugs pose a serious risk to aviation safety. Their short- and long-term effects may be unpredictable and result in pilots being impaired when flying their aircraft.

2. Conduct of the inquiry

2.1 On 14 February 2017 the Transport Accident Investigation Commission (Commission) learned through the media of a helicopter accident on the Port Hills. A Commission investigator arrived at the accident site about one hour later and made an initial assessment of the accident circumstances. The Commission opened an inquiry under section 13(1) of the Transport Accident Investigation Commission Act 1990 and appointed an investigator in charge.

2.2 On 15 February 2017 two additional investigators arrived in Christchurch to assist in the site examination. The wreckage was removed the next day and taken to the Commission's technical facility in Wellington.

2.3 In accordance with Annex 13 to the Convention on International Civil Aviation, the Commission notified the accident to the Bureau d'Enquêtes et d'Analyses (BEA), France being the state of manufacture (helicopter). On 16 February 2017 the BEA appointed an Accredited Representative for France and appointed Airbus Helicopters as its Technical Adviser.

2.4 In accordance with Annex 13 to the Convention on International Civil Aviation, the Commission notified the accident to the National Transportation Safety Board of the United States, being the state of manufacture (engine). The Board elected to not appoint an Accredited Representative, but offered technical support.

2.5 On 17 February 2017 the investigation team conducted witness interviews and gathered relevant information.

2.6 On 8 March 2017 a recording from a digital video camera that had been externally mounted on the helicopter was obtained from the Police, who had initially retrieved the camera from the accident site. The video recording was later analysed by the BEA for the Commission.

2.7 The video recording revealed that an object had fallen from the helicopter during the accident sequence. The Commission mounted a ground search in rough scrub terrain for the object and also used a New Zealand Fire Service remotely piloted aerial system. The object was not found.

2.8 On 11 May 2017 the Commission published Interim Report AO-2017-001. The interim report recommended that the Director of Civil Aviation use the interim report, Eurocopter Service Letter No. 1727-25-05 and any other pertinent material to remind the aviation industry of the lessons learned from accidents involving underslung loads, in particular the use of monsoon buckets[3] during firefighting operations.

2.9 In April 2017 the Institute of Environmental Science and Research completed toxicology testing of samples taken from the deceased pilot. Further testing was undertaken in September 2017 by a forensic laboratory in the United Kingdom. A forensic toxicology expert[4] in Australia interpreted both test results for the Commission.

2.10 On 21 March 2018 the Commission approved the circulation of the draft report to interested persons for comment.

2.11 Five submissions were received. The Commission considered the submissions, and changes as a result of those submissions have been included in the final report.

2.12 On 24 May 2018 the Commission approved the final report for publication.

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[3] Large buckets, slung beneath helicopters, for dropping water on a fire or other target.
[4] Professor Olaf H Drummer, Dr.h.c.(Antwerp), PhD (Melb), BAppSc (RMIT), FFSC, FRCPA, FACBS, CChem; Professor (Forensic Medical Science), Department of Forensic Medicine, Monash University.

3. Factual information

3.1 Narrative

3.1.1. On the afternoon of 13 February 2017, wildfires broke out on the Port Hills between Lyttelton Harbour and the south-eastern suburbs of Christchurch. The National Rural Fire Authority[5] was controlling the response. It contracted helicopter companies to survey the extent of the fires and to evacuate a number of people. Way To Go Heliservices Limited (the operator) provided one of the helicopters, a Eurocopter AS350 BA 'Squirrel' registered ZK-HKW (the helicopter). The pilot flew back to the operator's base at Rangiora Airfield at about dusk.

3.1.2. At about 0540 the next day the same pilot flew the helicopter from Rangiora to re-join the firefighting operation, which now involved more helicopters and occasionally two aeroplanes. At the staging area the fire authority's 'air attack supervisor' (the supervisor) briefed the pilots on the situation and the planned operations for that day. The briefing covered the expected weather, any known hazards and the general procedures to be followed. The supervisor was an experienced park ranger who was familiar with the area and had extensive experience in fighting wildfires and in controlling firefighting aircraft. The supervisor oversaw the aviation effort from an airborne helicopter.

3.1.3. The supervisor allocated the aircraft to separate sectors of the fire and appointed a lead pilot for each sector. The pilot of the accident helicopter was appointed lead pilot for the three helicopters in his sector.

3.1.4. After receiving further instructions from the supervisor, the pilot briefed the other pilots in his group on the agreed circuit pattern and the radio procedures. The circuit pattern between the dipping ponds[6] and drop points allocated to each group provided separation from other groups, but each pilot remained responsible for their own aircraft's safe operation.

3.1.5. The pilot's group operated at several locations on the Port Hills during the morning. After a lunch and refuelling break, the group was directed to drop water on fires near the 'Sign of the Kiwi', a historic building at the junction of Summit Road and Dyers Pass Road. The dipping pond was adjacent to Summit Road, about two kilometres northeast of the fires.

3.1.6. The pilots flew a left-hand pattern in clear conditions between the dipping pond and the fire, around Sugarloaf peak[7] (see Figure 1). On the return leg to the dipping pond, the helicopters flew over prominent ridges south of Sugarloaf. One ridge was a 50-metre-high rocky outcrop with a cliff face on the west side. The time taken to complete one circuit, from dipping to returning to the pond after dropping the water on the fire, was approximately four minutes.

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[5] On 1 July 2017 the National Rural Fire Authority merged with urban fire services to form Fire and Emergency New Zealand.
[6] Locations for filling buckets.
[7] Sugarloaf is a Port Hills landmark 494 metres above sea level, with a 121-metre-high mast on the summit.

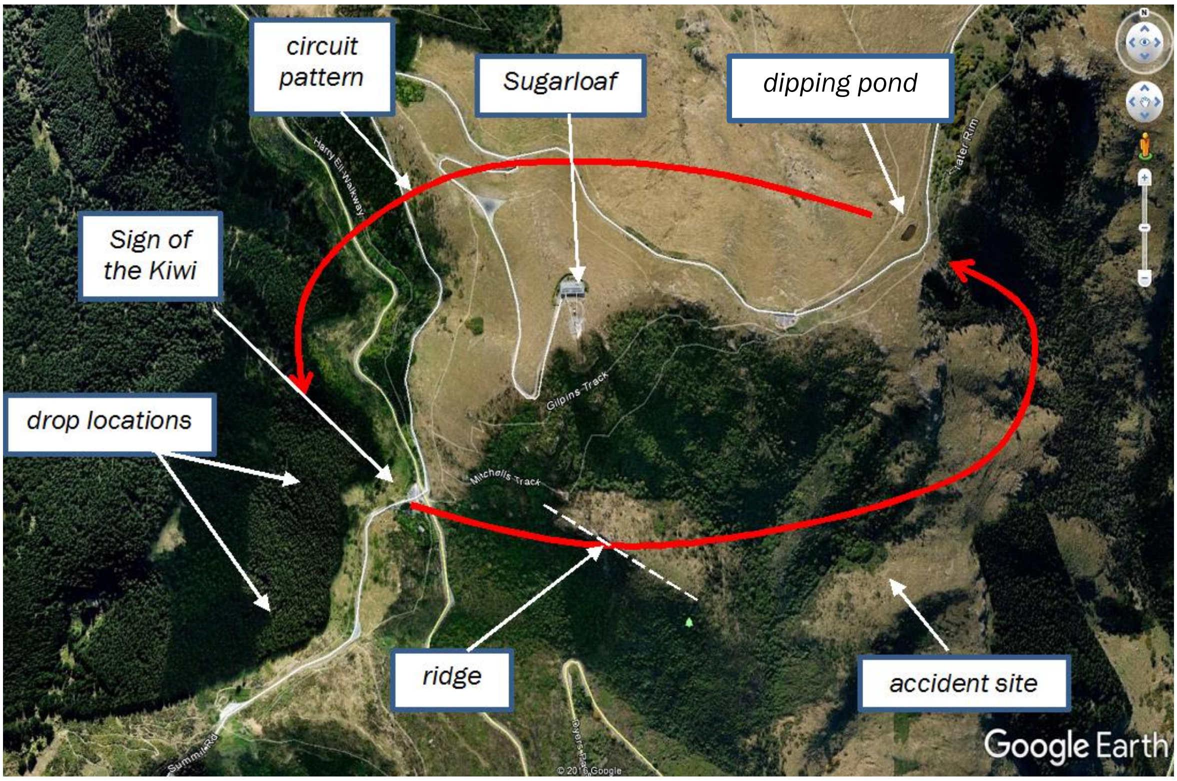

Figure 1
Location map showing helicopter circuit

3.1.7. At about 1405 an abbreviated 'Mayday' call[8] was heard by several pilots, but it was not clear on which radio frequency the call had been made. The supervisor asked for a roll call of all aircraft, to which the pilot did not respond. Another pilot soon found the wreckage of the helicopter near the head of a gully east of Sugarloaf. The pilot had been fatally injured.

3.1.8. A witness located at Governors Bay, two kilometres south of Sugarloaf, later reported having seen an object fall from the helicopter and the helicopter pitch up before it disappeared behind a ridge.

3.1.9. The supervisor instructed all pilots to return to the staging area and to shut down. Firefighting flights did not resume until the pilots had been debriefed and had a mandatory rest, and each had decided whether to continue firefighting that day.

3.2 Personnel information

3.2.1. The pilot had begun his training to fly helicopters in August 1998 and gained his commercial pilot licence in 2002. His total helicopter flying experience was about 2,350 flight hours, of which about 500 hours had been on the AS350 helicopter type.

3.2.2. In January 2008 he had joined the operator, initially as a contract pilot and ground crew member. He had left the operator in August 2009, but returned in January 2013 as a full-time pilot.

3.2.3. The pilot had commenced underslung-load training in March 2013, and at the time of the accident had accrued about 80 hours of such work. He held a 'B category' instructor rating, issued in September 2015, and a Grade 2 agricultural rating that had been issued in December 2016.

[8] A distress message indicating a condition of being threatened by serious and/or imminent danger and of requiring immediate assistance.

3.2.4. The pilot held the 'Senior Person' roles[9] of quality assurance manager and training manager for the operator. He also trained fire service personnel in working with helicopters in a firefighting role.

Medical

3.2.5. The pilot held a class 1 medical certificate with no restrictions, valid until 26 February 2017. He was said to have been healthy and in good spirits on the day of the accident.

3.2.6. The post-mortem examination of the pilot determined that he died as a result of multiple high-energy-impact injuries. The examination found no sign of any pre-existing neurological or cardiovascular disease.

3.2.7. Through interviews with people closely associated with the pilot, it was established that he was an occasional user of cannabis, and had smoked cannabis when he was off duty two days before the accident.

3.2.8. A screening test detected cannabis metabolites in samples of the pilot's blood and urine. The tetrahydrocannabinol (THC)[10] concentration in the blood was 0.6 micrograms per litre, and THC-acid was confirmed in the urine sample.

3.2.9. Additional testing was undertaken in order to establish the relationship between the screening results and the pilot's recent use of cannabis. An expert forensic toxicologist reviewed the test evidence and concluded that the pilot was "unlikely to have been under the influence of cannabis at the time of the accident".

3.2.10. Pilots must complete a questionnaire when applying to the Civil Aviation Authority (CAA) for a medical certificate. One of the questions is, "Have you ever had any experience with the following: use of legal or illegal recreational drugs or substances?" The pilot had answered "No" on his most recent medical certificate application form, dated 24 February 2016.

3.3 Aircraft information

Figure 2
Helicopter orientation

3.3.1. The helicopter had been manufactured in France in 1980 and imported into New Zealand in January 2015. It had flown for a total of 9,127 hours.

[9] Senior Persons are mandated management positions for certificated operators. Holders are approved by the Civil Aviation Authority.
[10] The principal psychoactive constituent of cannabis.

3.3.2. An annual review of airworthiness had been completed on 1 February 2017. The most recent scheduled maintenance had been a 150-hour/annual airframe inspection performed on 8 February 2017.

3.3.3. Pilots flew the helicopter from the right seat. They were assisted in performing underslung-load tasks, such as firefighting, by various modifications to the helicopter. The pilot's seat could be locked in a position offset to the right of the normal position, which allowed a pilot a better view downwards on that side. The floor contained a window, outboard of the pilot's seat, to observe an underslung load. The collective lever[11] had an extension to ensure that the pilot had full control when their seat was in the offset position.

3.3.4. A rear-facing mirror was installed under the nose of the helicopter on the right side. This enabled a pilot to see an underslung load during normal flight.

3.3.5. The front seats were equipped with four-point harnesses. The shoulder straps for each seat had a common, lockable inertia reel mounted on the rear of the seat. The front-seat lap belt buckles had non-rotating, lifting catches. The adjustable lap belts were anchored to the floor.

3.3.6. The helicopter was fitted with sliding doors on the left side of the cabin and standard doors on the right side. To further improve the pilot's view of the underslung bucket while firefighting, all the doors on the right side had been removed and the doors on the left side were closed. A supplement to the AS 350 BA flight manual stated that this particular door configuration was prohibited for the helicopter[12]. The operator said that it considered that the supplement was ambiguous and was not aware that the configuration was prohibited.

3.3.7. Some later variants of the AS350 helicopter were approved to operate with the above door configuration up to an airspeed limit of 110 knots[13]. Airbus Helicopters advised that one reason for this lower speed limit for variants approved to fly with the above configuration was to prevent air pressure differences applying excessive force to parts of the cabin. The pilot had removed the rear seat cushions from the cabin to eliminate the risk of their being blown out of the cabin and striking the main or tail rotor.

3.3.8. The monsoon bucket was a 'Cloudburst 1000' model, a collapsible type with a capacity of 1,000 litres[14]. It was attached to a strop approximately six metres in length, making a total underslung load length of approximately 10 metres below the helicopter hook. The bucket manufacturer advised that the complete bucket assembly weighed approximately 62 kilograms. The manufacturer did not state any airspeed limitations, but said feedback from operators was that an empty bucket flew well at speeds up to 100 knots. The maximum load permitted on the hook was 750 kilograms[15]. The flight manual supplement for the hook gave an absolute airspeed limit of 80 knots when loaded, and contained a note stating: "The pilot is responsible for determining the limit speed according to the load and sling length".

3.3.9. The bucket was filled by lowering it into a dipping pond, or it could be landed and filled from hoses. The water drop valve was electrically commanded by a button on the pilot's cyclic stick[16]. The valve was pneumatically[17] actuated by helicopter engine bleed air supplied through a detachable, flexible hose.

3.3.10. The flight manual carried in the helicopter did not contain information on the Cloudburst bucket, and the operator was unable to provide its specifications. Therefore, the operator's

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[11] The flight control that changes the pitch of all the main rotor blades collectively to change the thrust of the main rotor.
[12] AS 350 BA flight manual supplement number 13.
[13] The absolute 'never exceed' speed at sea level with all doors fitted and closed was 155 knots.
[14] 1,000 litres of fresh water weigh 1,000 kilograms.
[15] AS 350 BA flight manual supplement number 12.
[16] The flight control that alters the tilt angle of the main rotor disc and thus the direction in which the helicopter flies.
[17] Operated using air pressure.

pilots did not have ready access to information necessary for calculating the operating weight when firefighting.

3.4 Meteorological information

3.4.1 An automatic weather station was located on Sugarloaf, approximately 500 metres from the scene of the accident. The wind at the estimated time of the accident was from 273 degrees true[18] (˚T), varying between 264˚T and 279˚T, with the speed between 20 and 29 knots.

3.4.2 The other pilots operating in the circuit around Sugarloaf before the accident had noted a moderate to strong west to northwest flow with light turbulence, but it had not been a concern to them. However, the pilot of one of the first helicopters to respond to the accident said, "It was windy and a bit of a struggle in [a Kawasaki BK117]".

3.4.3 Approximately 85 minutes after the accident, the supervisor stopped helicopter operations in a fire sector three kilometres southwest of Sugarloaf because of reported wind shear[19].

3.5 Wreckage and impact information

3.5.1. The helicopter struck a steep, tussock-covered slope. Main rotor strikes on the slope indicated that the helicopter had been banked steeply and in a nose-down attitude when it struck the ground. It had then rolled 40 metres down the slope and come to rest upside down.

3.5.2. The damage to the fuselage was predominantly to the front right of the cabin. The pilot's body was found outside the fuselage with his helmet nearby.

3.5.3. The fuel tank remained intact and was approximately a quarter full. There was no fire.

3.5.4. The main rotor and transmission, and the engine, were adjacent to but separated from the fuselage. The damage to the main rotor blades was consistent with the rotor having been driven by the engine at impact.

3.5.5. The tail rotor assembly, including the gearbox, was with the fuselage but had separated from the tail boom. The tips of the glass-fibre tail rotor blades were missing. Marks on the tail rotor blades were consistent with their having struck the wire suspension cables for the monsoon bucket. There was corresponding damage on the cable cluster where the suspension cables joined to the lifting strop (see Figures 3 and 4). The strop was still attached to the helicopter hook.

3.5.6. The end of the tail boom, complete with the upper and lower vertical stabilisers, had separated from the helicopter. It was found in vegetation approximately 300 metres before the main wreckage. The damage to the vertical stabilisers was consistent with ground impact. The fracture surfaces of the tail boom structure and the vertical stabiliser showed no sign of any pre-existing defects.

3.5.7. All major components of the helicopter were accounted for, except for the window panel from the left rear sliding door. The rubber window seal was retained in the door panel.

[18] With reference to true north.
[19] A change in wind speed and/or direction over a relatively short distance.

Figure 3
Damage to the leading edge of one of the tail rotor blades

Figure 4
The monsoon bucket cable cluster with broken shackles and damaged cables

3.6 Survival aspects

3.6.1 The helicopter was fitted with a 406-megahertz emergency locator transmitter (ELT). The ELT activated as a result of the impact, but it was not until 1533 (approximately one and a half hours after the accident) that the ELT signal was reported to Rescue Coordination Centre New Zealand. The rescue coordination centre advised that the detection was by a low-earth-orbit satellite only.

3.6.2 The roof-mounted antenna had separated from the coaxial cable that connected it to the ELT. As a result, a very weak signal was being transmitted. Consequently, a satellite had to be in a low orbit and nearly overhead in order to detect such a weak signal.

3.6.3 The Commission has noted in previous reports the poor reliability of ELTs and has made recommendations to the Director of Civil Aviation concerning the issue[20]. The Commission has also included the issue as a transport-related concern in its Watchlist[21].

3.6.4 The floor attachments for the pilot's seat had failed in the heavy impact with the ground. The inboard lap belt had been forcibly pulled through its floor-mounted adjusting mechanism, leaving the pilot unrestrained. Although the other three points of the harness had remained firmly connected to the seat belt buckle, the disconnected lap belt resulted in the pilot being thrown from the cabin.

3.6.5 The pilot had been wearing a helmet, but the impact forces were not survivable.

3.7 Recorded data

3.7.1 The helicopter had a TracMap® global positioning guidance system on board, but this was not switched on and contained no data from the flight.

3.7.2 The flight took place in uncontrolled airspace and was not recorded by the air traffic control radar system.

Witness video recording

3.7.3 A mobile phone video recording taken by a witness who was situated on Summit Road close to the Sign of the Kiwi showed the helicopter flying in the same circuit around Sugarloaf on the morning of the day of the accident.

3.7.4 The recording showed the helicopter flying with a full bucket toward the drop point, dropping the water on the fire, then continuing over Dyers Pass Road towards the dipping pond. The video recording showed how the empty monsoon bucket trailed behind the helicopter in normal flight under the conditions at that time (see Figure 5).

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[20] For example, inquiry report 2011-003, in-flight break-up, ZK-HMU, Robinson R22, near Mount Aspiring, 27 April 2011.
[21] See https://taic.org.nz/watchlist/technologies-track-and-locate.

Figure 5
Video image taken earlier the same day, showing the helicopter with the empty bucket trailing

On-board video recording

3.7.5 A digital video camera was mounted under the forward fuselage, on the helicopter centreline, aimed down and rearwards toward the monsoon bucket. It was attached to the bracket that supported the helicopter's rear-facing mirror. The camera also recorded sound.

3.7.6 The on-board video camera recorded all the flights on the day of the accident and the previous day. The camera had a clear view of the monsoon bucket in flight and when filling at the dipping pond, the front parts of the landing gear and the ground underneath the helicopter. The video recording enabled the normal in-flight behaviour of the bucket to be compared with its behaviour on the accident flight (see Figure 6).

Figure 6
On-board video image corresponding to the time of the image shown in Figure 5

3.7.7 The track flown, the height above ground, the groundspeed and the relative movement of the helicopter were estimated from the video[22].

3.7.8 Changes in the position of the video frame with reference to the landing gear indicated the relative movement of the camera as it flexed on its mount (compare Figure 5 and Figure 6).

3.7.9 The on-board video data was sent to the BEA for further analysis of the images and sounds.

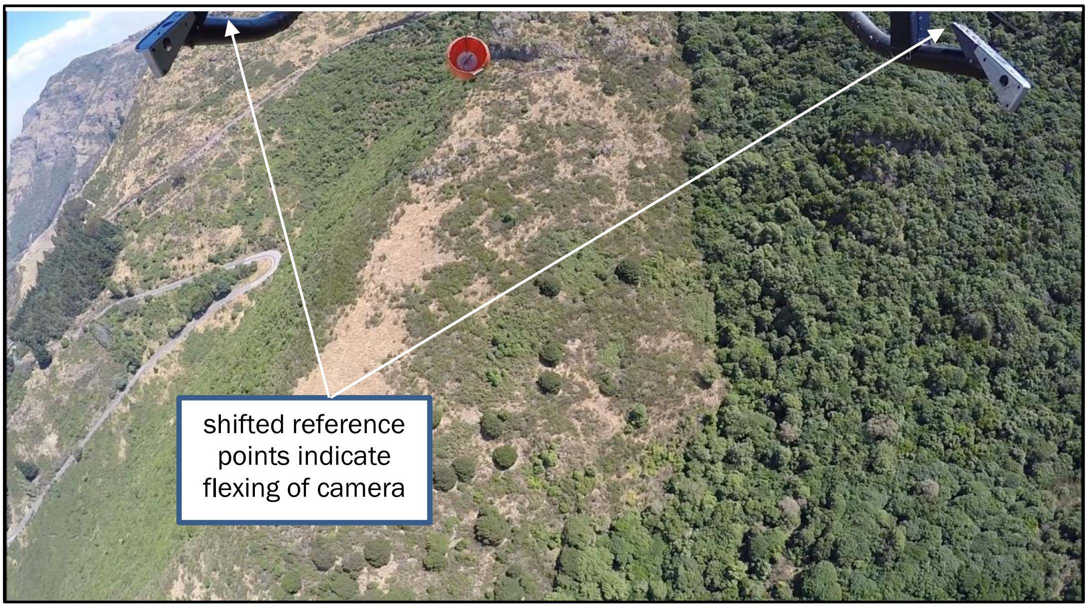

Figure 7
Video capture showing the camera mount flexing rearward, when the bucket was rapidly ascending immediately before it made contact with the tail rotor

[22] Speed and direction were calculated using the time and distance between two clearly identified features.

3.8 Organisational and management information

The operator

3.8.1 The operator was certified under Civil Aviation Rules Part 119 to conduct commercial and charter operations. It had been performing commercial work in the Canterbury region since 2009, and operated multiple helicopter types.

3.8.2 The chief executive was the operator's chief pilot.

3.8.3 Civil Aviation Rules Part 119 did not require helicopter operators to have drug and alcohol management systems, although the operator did have reference to such policies in its safety manual.

Firefighting operations

3.8.4 Firefighting air operations are regulated by Civil Aviation Rules Part 91, General Operating and Flight Rules, and Part 133, External Load Operations. At the time of the accident the interaction of air operations with the rural fire authorities was covered by a New Zealand Standard – National Rural Fire Authority: Standard for use of aircraft at wildfires, RF300, first issued in August 2015.

3.8.5 The standard required an air operator to apply to the National Rural Fire Authority for a certificate of compliance (with the standard) before the operator could be considered for tasking on a firefighting mission controlled by a rural fire authority. The application required a declaration by the operator of its compliance with the requirements of the standard[23], and verification by a rural fire authority that the operator was experienced in aerial firefighting.

3.8.6 On 30 September 2016 the operator had been issued with a National Rural Fire Authority Interim Certificate of Compliance for an Aircraft Operator. The interim status was for a period of 36 months from the date of issue, or until the operator had passed a formal audit by the National Rural Fire Authority, whichever was sooner. The audit had not yet been conducted at the time of the accident.

Previous incident

3.8.7 In January 2015 a wildfire had occurred at Flock Hill Station near Craigieburn Forest Park in Canterbury. The fire had been on Department of Conservation land therefore the department had been responsible for fighting the fire.

3.8.8 The pilot had assisted in the fighting of that fire over a number of days, flying a monsoon bucket with the same helicopter. During that task the window panel from the left rear sliding door had fallen from the helicopter.

3.8.9 The Department of Conservation rural fire officer in charge of the firefighting effort recalled that he had noted the missing window by chance, and that the pilot had told him that it had happened because he had been flying too fast. The rural fire officer had recorded the event on an incident reporting card, but no further investigation had been undertaken.

3.8.10 At the briefing for all personnel the next day, the rural fire officer had referred to the loss of the window as "flying too fast" and reiterated to the pilots that their flying had to be 'SEEL' (safe, effective, efficient and bound by logistical limitations). The rural fire officer said that the

[23] The general contractual provisions [see https://fireandemergency.nz/about-us/general-contractual-provisions] of Fire and Emergency New Zealand include requirements for contractors to: operate in compliance with applicable user requirements, specifications and standards; and perform the service using due diligence, care and skill, and with sufficient appropriately trained, qualified, experienced and supervised persons. Contractors are required to ensure that each service, prior to acceptance, complies with all New Zealand laws, codes and standards.

incident had been included in the operational debrief held after firefighting activities were complete.

3.8.11 The operator's chief pilot/chief executive had been aware of this incident, but it had not been recorded in the internal quality assurance system and no internal investigation had been conducted. The operator had not notified the incident to the CAA, as required by Civil Aviation Rules Part 12: Accidents, Incidents, and Statistics. However, the maintenance logbook recorded that a new window had been installed on 30 January 2015.

3.8.12 The pilot had logged approximately 75.5 hours of underslung-load operations, including firefighting, in the helicopter since the Flock Hill Station incident.

4. Analysis

4.1 Introduction

4.1.1 The accident occurred during a complex, large-scale, airborne firefighting operation. The firefighting command and control system was functioning as planned, with no significant issues reported. The other pilots in the Sugarloaf circuit reported that the winds, although gusty at times, had not compromised the safe operation of their helicopters.

4.1.2 There had been no concern for the pilot's performance during the day of the accident. No prior abnormalities were reported with the helicopter that day, and the on-board video recording appeared to show normal flight operations.

4.1.3 The wreckage showed that the bucket suspension lines cluster had made contact with the tail rotor. The damage to the tail rotor blades and the subsequent separation of the vertical stabiliser caused the loss of control. The on-board video recording provided evidence that supported this conclusion.

4.2 What happened

Safety issue – There may not be a good awareness within the helicopter industry of the additional risks involved with underslung load operations, particularly with the use of monsoon buckets during firefighting operations.

4.2.1 On the final circuit the pilot was returning to the dipping pond to refill the monsoon bucket. The on-board video recording confirmed that at all times while in cruise flight the helicopter height provided clearance between the monsoon bucket and the ground.

4.2.2 The groundspeed of the helicopter when it crossed the rocky ridge south of Sugarloaf was estimated on the accident circuit, and several circuits beforehand, to have been between 80 and 90 knots. The door configuration in use at the time of the accident (two right-hand standard doors removed and the left-hand front and left rear sliding door closed) had not been tested by Airbus Helicopters for the AS350 BA variant, and for that reason the configuration was prohibited. Although other variants of the AS350 could operate safely with this door configuration, it was not possible without flight test data for the AS350 BA to determine the extent to which the airspeed was a factor in the loss of the window. The combined effect of air speed and turbulence is discussed in the following section.

4.2.3 Shortly after the helicopter passed over the rocky ridge, the video recording showed slight transient movements in pitch and roll. A vibration went through the monsoon bucket and the strop, as had happened on previous passes over the ridge, and the tension in the suspension line relaxed. This time the bucket rose quickly until it went out of view of the camera. The bucket had also risen out of camera view at a similar place on some earlier circuits, but for less time.

4.2.4 When the bucket moved out of camera view, the frame of the video recording in relation to the landing gear reference points changed (refer to paragraph 3.7.8). This was most likely the result of rearward pressure on the camera because of an increase in airspeed.

4.2.5 The transient pitch and roll changes could have been made by the pilot. However, when considered with the apparent airspeed increase and the vibration of the suspension lines and strop, it was very likely that these were all signs of turbulence and wind shear.

4.2.6 Although this had occurred at most other times during the numerous circuits when the helicopter had crossed the ridge, it was significantly more pronounced on the last circuit.

4.2.7 The BEA analysis of the video recording identified a loud sound at this time. An abrupt increase in pitch attitude of the helicopter occurred shortly after the loud sound. Shortly afterwards, a second loud sound was heard, accompanied by a sudden and short-duration, high-frequency airframe vibration. The background sound, corresponding to the frequency of the tail rotor, then ceased.

4.2.8 It is virtually certain that the second loud sound and the high-frequency airframe vibration occurred when the monsoon bucket and the tail rotor made contact. The tail rotor blades were largely destroyed by this contact.

4.2.9 The source of the first loud sound and the relevance of the abrupt pitch change are discussed below.

Other objects seen in the video

4.2.10 After the airframe vibration occurred, two airborne objects appeared below the helicopter very briefly (see Figure 8).

Figure 8
Two objects beneath the helicopter

4.2.11 Approximately four seconds later the vertical stabiliser assembly could be seen falling to the ground (see Figure 9).

Figure 9
The vertical stabiliser falling to the ground (cropped image)

4.2.12 A close examination of the images of the left object (viewed in the camera direction) determined that the object appeared to be light weight, of rectangular form, and highly reflective (see Figure 10). The object's brightness varied frequently because it was tumbling.

Figure 10
Magnified view from the video recording of the leftmost airborne object

4.2.13 It is virtually certain that this object was the missing window panel. Although the window was transparent, it was tumbling and appeared bright when it reflected the sun and was invisible when edge on.

4.2.14 The door configuration meant that the window was likely subjected to fluctuating pressure as the helicopter encountered turbulence and wind shear while flying at the estimated 80-90 knots. It is very likely that the window panel was dislodged from the door by a sudden increase in air loading due to turbulence or a change in airspeed. The first loud noise in the video sound analysis was very likely the window being dislodged.

4.2.15 The dislodging of the window would have caused a sudden change in airflow through the cabin and an increase in noise and a sharp sound. This would have been of immediate concern to a pilot. It would be typical for a pilot to instinctively reduce speed under such circumstances. In a helicopter the speed is reduced by moving the cyclic aft, called a 'flare' manoeuvre, which pitches the nose up (and the tail down). This pitch change was discernible in the video recording after the first loud sound, and corresponded with what the witness at Governors Bay[24] reported seeing just before the helicopter crashed.

4.2.16 At the same time that the tail was lowering, the monsoon bucket was rapidly rising from the transient airspeed increase. The convergence resulted in cables from the strop entering the tail rotor disc, causing the damage that resulted in the pilot losing control of the helicopter.

4.2.17 The need to abruptly flare a helicopter with an underslung load is unusual. The Commission considered other reasons for the pilot making an abrupt pitch-up.

4.2.18 One reason could have been a 'startle effect' following the window suddenly dislodging. The level of surprise or startle that a pilot might experience when something unexpected occurs could be significant. Startle can be detrimental to their handling of the event. Simons (1996) suggests that when people are subjected to some sort of startling stimulus when a real threat exists, the intensity of that startle is increased[25]. The pilot's experience in firefighting environments would likely have made him less susceptible to this reaction. It was not possible to determine whether the 'startle effect' was a factor in this accident.

4.2.19 Another reason could be that the pilot made an avoiding manoeuvre for some reason, such as to avoid a bird.

4.2.20 The object seen to the right in the video recording appeared to be small and animated, with an irregular shape (see Figure 11). This object went out of view for a few frames then reappeared briefly.

[24] Refer to paragraph 3.1.8.

[25] The Effects of Startle on Pilots During Critical Events: A Case Study Analysis. Wayne L Martin, Patrick S Murray, Paul R Bates, Griffith University, Brisbane, Australia 2012.

Figure 11
Further magnification of the right most object

4.2.21 It is very unlikely that this object was a section of tail rotor blade, because it came from ahead of the helicopter. The object was more likely to have been a bird, as the motion resembled the flapping of a bird's wings.

4.2.22 Although the normal response of a pilot to avoid a head-on collision with a bird would be to pitch up, the bird did not come into view until after the pitch-up. The time interval, and the distance below the helicopter when the object passed, suggests that the pitch-up was not a collision-avoidance manoeuvre. However, the possibility that the pilot was manoeuvring to avoid something could not be excluded.

Findings

1. The helicopter was being operated with a door configuration that was prohibited, and was therefore being flown outside the manufacturer's approved limits.
2. It was about as likely as not that the door configuration contributed to the fluctuating pressure caused by the forward airspeed and turbulence, and that this dislodged the window.
3. The pilot lost control of the helicopter when the tail rotor assembly was damaged as it came into contact with the cables under which the monsoon bucket was suspended.
4. The cables were able to strike the tail rotor due to the combined effect of the monsoon bucket flying back and upward, induced by wind shear and turbulence, and the tail boom dropping as the helicopter pitched up.
5. It was about as likely as not that the helicopter pitched up due to the pilot reducing speed in response to the noise of the rear door window popping out of its frame.

4.3 Window installation

4.3.1 The maintenance instructions for the helicopter specified that the window panel was to be held in the door aperture by a 'Z'-shaped rubber seal around its edge. A line of sealant placed around the seal lip prevented moisture ingress and helped to keep the window centred. The manufacturer said that the sealant helped to maintain the window in place under flight loads, although its tests and analyses were performed without the sealant.

4.3.2 The installation instructions specified that the rubber seal was to be fitted to the door so that the window panel was located on the inside of the door profile, and the edge of the window panel overlapped the edge of the aperture in the door by at least three to six millimetres. This design was to prevent the window panel being accidently dislodged and falling outwards from the door. The design would not have prevented the window falling inwards in the event of it being dislodged.

4.3.3 However, as the window panel was not found, the overlap dimensions and whether any sealant was on the window panel could not be determined.

4.3.4 The helicopter manufacturer advised of a similar occurrence in Europe in 2002, when a window panel fell out of a rear door. The main rotor blades were damaged in the incident. That investigation determined that the window had very recently been installed incorrectly, using soapy water to aid installation.

4.4 Strop length

4.4.1 The pilot was flying with a shorter strop than those that most of the other helicopters were using that day. There were advantages or disadvantages to using a short strop, but there was no evidence to show that a short strop was more dangerous than a longer one. Industry advice was that strop length was determined largely by a pilot's preference. Although a longer strop would have resulted in the bucket suspension cable cluster trailing farther behind the tail rotor, any contact of the strop itself with the tail rotor could have had similar consequences.

4.5 Operator procedures

Safety issue – The operator did not have adequate systems available for the pilot to determine the actual all-up weight and balance of the helicopter for the firefighting operation, or to ensure that incidents such as the previous loss of a window were recorded, notified to the CAA and investigated.

Weight and balance

4.5.1 The on-board video recording showed that the pilot filled the 1,000-litre bucket to capacity each time it was dipped into the pond. He had no reliable means of filling the bucket only to the 750-kilogram load limit for the hook. A line had been painted inside the bucket, but it had faded. The line was not visible on the video recording and it is unlikely that the pilot could see it clearly. Although the pilot had the option of subsequently releasing some water by briefly opening the bucket valve, video evidence showed that it was virtually certain that the initial part of each circuit began with the bucket weight exceeding the hook load limit.

4.5.2 The capacity of the bucket allowed an opportunity for the hook load limit to be exceeded; this ought to have been recognised as a risk when planning for the task. There are buckets available that have removable bungs in their walls, so that the capacity can be restricted.

4.5.3 The right doors had been removed for the firefighting mission, but that was a prohibited configuration for the AS350 BA helicopter. It is very likely that the configuration had been considered acceptable because it was permitted on some other AS350 variants. However, operating limitations often differ between similar variants of an aircraft. Operators and pilots must know and adhere to the limitations published in the applicable flight manuals.

4.5.4 The cabin had been stripped of seats and loose items to eliminate the risk of an object falling through the open doors and hitting the main rotor or the tail rotor. This would have reduced the empty weight of the helicopter. However, the operator had not provided a revised weight and balance sheet for this different empty configuration.

4.5.5 As there was no flight manual supplement for the Cloudburst bucket, the weight of the bucket and attached lines was not readily available to pilots.

4.5.6 The helicopter was recovered with an estimated 25% of fuel capacity on board. The maximum all-up weight with an external load was 2,250 kilograms. This weight could be reduced to that at which an out-of-ground-effect[26] hover could be maintained. The weight of the helicopter on the accident flight was not ascertained accurately because of the above variables. However, the weight very likely exceeded the flight manual limit whenever the bucket was filled to capacity.

4.5.7 It could not be determined whether the pilot had calculated the revised weight and balance for the configuration and the actual underslung load.

4.5.8 In its report on a heli-skiing accident on Mount Alta in 2014[27], the Commission had raised the safety issue of New Zealand helicopter pilots working in a culture of operating outside the manufacturers' published and placarded 'never exceed' limitations, including the maximum allowable weight limitations. The Commission had recommended that the Director of Civil Aviation include the safety issue of helicopter operational culture in its current 'sector risk profile' review.

4.5.9 Although the monsoon bucket was empty at the time of this accident, and therefore overloading was not a factor contributing to the accident, the helicopter was very likely overloaded each time the monsoon bucket was filled at the dipping pond.

Non-reporting of previous incident

4.5.10 The loss of the window panel during the 2015 Flock Hill Station fire met the criteria of an occurrence that should have been notified to the CAA, in accordance with Civil Aviation Rules Part 12. This is specified in CAA Advisory Circular AC 12-1 Mandatory Occurrence Notification and Information Appendix A – Aircraft Systems Incidents.

4.5.11 A strike on the tail rotor by the window panel had the potential to cause significant damage to the tail rotor. Therefore, the window panel entering the airflow along the right side of the helicopter in forward speed could present a hazard to the safety of the helicopter.

4.5.12 In accordance with Civil Aviation Rules Part 12, the operator was required to notify this occurrence to the CAA and provide a report on its investigation of the incident. The non-notification of this event meant that follow-up by the CAA and the wider dissemination of any safety lessons could not occur.

4.5.13 The Civil Aviation Rules also required that the operator establish an internal quality assurance system that included, in part:

- a safety policy and safety policy procedures, including the procedure for occurrence investigations conducted in accordance with Part 12; and
- a procedure to ensure quality indicators, including defect and incident reports, and personnel and customer feedback, are monitored to identify existing problems or potential causes of problems within the system; and
- a procedure for corrective action to ensure existing problems that have been identified within the system are corrected; and

[26] Hovering close to the ground normally results in a positive influence on lift characteristics of the helicopter's main rotor therefore more power is required to maintain a hover out of ground effect.
[27] Commission report AO-2014-005, Eurocopter AS350-B2 (ZK-HYO), collision with terrain during heliski flight, Mount Alta, 16 August 2014.

- a procedure for preventive action to ensure that potential causes of problems that have been identified within the system are remedied.

4.5.14 The fact that the 2015 Flock Hill Station fire window loss had not been investigated by the operator, or notified to the CAA, was a missed opportunity for the operator to understand the circumstances and take preventive action.

Findings

6. The operator had not provided its pilots with all the information necessary to determine the actual weight and balance of a helicopter when it was in the firefighting configuration.
7. It was virtually certain that the helicopter all-up weight exceeded the flight manual limit each time the Cloudburst 1000 monsoon bucket was filled to capacity.
8. The non-notification of the earlier window loss to the CAA and the pilot being able to overload his helicopter during the firefighting operation are indications that the operator's quality assurance system should be reviewed.

4.6 Substance use

4.6.1 The Commission regards the use of recreational drugs by active pilots as a significant safety concern. Trace evidence of cannabis use was found in the toxicological analysis of samples taken from the pilot. The expert forensic toxicologist was of the opinion that the pilot was 'unlikely' to have been under the influence of cannabis at the time of the accident.

4.6.2 Therefore, substance use is very unlikely to have been a factor contributing to this accident. However, as pilots may not know when they will be next required for duty, and the short- and long-term effects of cannabis use are variable, the use of cannabis at any time poses a serious risk to aviation safety. While not causal, substance use is part of the circumstances of this accident that the Commission believes has significant implications for transport safety.

4.6.3 The regulatory environment for preventing performance impairment through substance use is currently on the Commission's published watchlist. The stated problem is that judgement, decision-making, and reaction time can all be affected by the use of drugs or alcohol. The use of performance-impairing substances by persons performing safety critical tasks in a transport environment is a significant risk.

4.6.4 In its Medical Information Sheet CAA MIS 013, the CAA describes recreational drugs as "having a wide range of effects, and different people can respond / react to them in varying and different ways. In general terms the effects that are of aviation safety concern include:

- Changes to mental function, thinking, and decision making;
- Changes to the sensory functions of the body;
- Reduction in co-ordination and physical performance;
- Potential for incapacitation; and
- Changes to behaviour.

Some of these effects can occur because of the drug itself, and some can occur afterwards (like a hangover), or because of withdrawal from the drug".

4.6.5 In a previous report[28], the Commission had recommended that the Secretary for Transport complete, as a matter of priority, all necessary work that will support the introduction of appropriate legislation or rules that will:

- prescribe allowable maximum levels for alcohol
- prohibit persons from operating an aircraft, vessel or rail vehicle if they are impaired by drugs
- require operators to implement drug and alcohol detection and deterrence regimes, including random testing
- prescribe post-occurrence testing requirements for drugs and alcohol.

This legislation or these rules should apply:

- across the aviation, maritime and rail transport modes
- to persons operating an aircraft or a marine craft for recreational purposes. (012/13)

4.6.6 In 2015, noting several other cases where performance-impairing substances had been detected in persons in transport safety-critical roles, the Commission had published its Watchlist on substance abuse.

4.6.7 The Watchlist item 'Substance use: regulatory environment for preventing substance impairment'[29] described the Commission's concern about the lack of effective regulation against substance use by persons performing transport safety-critical tasks in a transport environment.

4.6.8 The CAA has since advised that air operators will be expected to include drug and alcohol policies in their safety management systems. The policies shall have provisions for random and post-incident testing of persons in safety-critical roles. The CAA specified in Advisory Circular AC100-1, Safety Management, that all operators should have their safety management systems approved by 1 February 2021.

4.6.9 The operator in this case had yet to establish an approved safety management system but did have a drug and alcohol policy and a policy for random or post-accident and -incident drug and alcohol testing in its safety manual. The chief pilot was not aware of the pilot's occasional cannabis use and said that the pilot had never presented under the influence at work. Random drug and alcohol testing had not been conducted.

4.6.10 On his application for a CAA medical certificate[30] the pilot had declared that he had no experience of recreational drugs. The Commission examined the issue of pilots not declaring their use of performance-impairing substances in a 2015 inquiry involving a fatal helicopter crash near Queenstown[31], although in that case the use had been for a medical condition.

4.6.11 As a result of that inquiry the Commission had recommended that the Director of Civil Aviation review the medical certificate application process to ensure that it promoted a positive reporting culture for applicants (recommendation 021/17).

4.6.12 The Director had replied:

> The CAA accepts… this recommendation and will do what it can to promote a "positive reporting culture" for medical certificate applicants to the degree it can do so while still acting decisively to protect the public interest when it has reasonable

[28] Aviation inquiry 12-001, hot-air balloon, collision with power lines and in-flight fire, near Carterton, 7 January 2012.
[29] https://taic.org.nz/watchlist/regulations-managing-substance-impairment.
[30] In this case, regarding the use of recreational drugs or substances. See paragraph 3.2.10.
[31] Report AO-2015-002R, Mast bump and in-flight break-up, Robinson R44, ZK-IPY, Lochy River, near Queenstown, 19 February 2015.

> cause for concern about matters of potential aeromedical significance. The CAA will review current processes in line with this recommendation by 1 December 2017.

4.6.13 This recommendation had been directed at improving the full disclosure of medical conditions. The effectiveness of the process remains heavily reliant on an applicant's full disclosure.

4.6.14 However, a limitation of the disclosure system is that pilots are unlikely to disclose that they use recreational drugs if they fear that in doing so they risk losing their medical certificates, and thus the privileges of their licences.

4.6.15 The CAA had advised before report AO-2015-002R was published that it had completed a review of the medical certificate application process, as recommended by the Commission in that inquiry, and potential policy changes were under consideration.

Finding

9. It was very unlikely that the pilot's recent use of cannabis impaired his performance at the time of the accident. However, the use of performance-impairing substances by pilots is a serious risk to aviation safety.

5. Findings

5.1 The helicopter was being operated with a door configuration that was prohibited, and was therefore being flown outside the manufacturer's approved limits.

5.2 It was about as likely as not that the door configuration contributed to the fluctuating pressure caused by the forward airspeed and turbulence, and that this dislodged the window.

5.3 The pilot lost control of the helicopter when the tail rotor assembly was damaged as it came into contact with the cables under which the monsoon bucket was suspended.

5.4 The cables were able to strike the tail rotor due to the combined effect of the monsoon bucket flying back and upward, induced by wind shear and turbulence, and the tail boom dropping as the helicopter pitched up.

5.5 It was about as likely as not that the helicopter pitched up due to the pilot reducing speed in response to the noise of the rear door window popping out of its frame.

5.6 The operator had not provided its pilots with all the information necessary to determine the actual weight and balance of a helicopter when it was in the firefighting configuration.

5.7 It was virtually certain that the helicopter all-up weight exceeded the flight manual limit each time the Cloudburst 1000 monsoon bucket was filled to capacity.

5.8 The non-notification of the earlier window loss to the CAA and the pilot being able to overload his helicopter during the firefighting operation are indications that the operator's quality assurance system should be reviewed.

5.9 It was very unlikely that the pilot's recent use of cannabis impaired his performance at the time of the accident. However, the use of performance-impairing substances by pilots is a serious risk to aviation safety.

6. Safety issues

6.1 There may not be a good awareness within the helicopter industry of the additional risks involved with underslung load operations, particularly with the use of monsoon buckets during firefighting operations.

6.2 The operator did not have adequate systems available for the pilot to determine the actual all-up weight and balance of the helicopter for the firefighting operation, or to ensure that incidents such as the previous loss of a window were recorded, notified to the CAA and investigated.

7. Safety actions

General

7.1. The Commission classifies safety actions by two types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that would otherwise result in the Commission issuing a recommendation

(b) other safety actions taken by the regulator or an operator to address other safety issues that would not normally result in the Commission issuing a recommendation.

Safety actions addressing safety issues identified by the Commission

7.2. On 26 June 2017 Airbus Helicopters issued (and subsequently revised) Safety Information Notice No. 3170-S-00, on safe operations with underslung loads (see Appendix 2).

Other safety actions addressing other safety issues

7.3. On 22 September 2017 the head ranger who was acting as a deputy principal rural fire officer for the Christchurch City Council Rural Fire Authority advised: "As part of our refresher training we will be highlighting the need to track and record these sorts of incidents [that occur during firefighting] and how to promulgate them to the correct people for the purposes of intervention or lessons learnt".

8. Safety recommendations

General

8.1. The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector. In this case, recommendations have been issued to CAA and Way To Go Heliservices.

8.2. In the interests of transport safety, it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

Early recommendation to the Director of Civil Aviation

8.3. The circumstances of this accident indicate that the pilot may not have been fully aware of the additional risks involved in underslung-load operations, particularly operations involving monsoon buckets.

On 26 April 2017 the Commission recommended that the Director of Civil Aviation:

> as a matter of urgency, use the interim report, a service letter from Airbus (Service Letter SL2527-25-05 – see Appendix 1) and any other pertinent material available to disseminate to industry the lessons learned from accidents involving sling loads, in particular the use of monsoon buckets (015/17)

On 2 May 2017 the CAA replied:

> Thank you for the opportunity to comment on the recommendation. The Director accepts the recommendation and will implement it as soon as practicable. In doing so, the CAA have a number of options available for alerting the aviation industry concerned. These options will be considered as to the preferred action response in due course.

On 11 April 2018 the CAA advised:

> The CAA wishes to advise that the New Zealand Helicopter Association was sent a Safety Bulletin Update 2017, (for circulation to its members) and to the remainder of the helicopter commercial sector by CAA via email. The content specifically targeted the associated TAIC recommendation (015-17) and referenced the interim TAIC report.

Recommendation to the operator

8.4. The operator did not have adequate systems available for the pilot to determine the actual all-up weight and balance of the helicopter for the firefighting operation, or to ensure that incidents such as the previous loss of a window were recorded, notified to the CAA and investigated. The use of a prohibited door configuration suggested inadequate awareness of and adherence to flight manual limitations, which often differ between otherwise similar variants of an aircraft.

On 23 May 2018 the Commission recommended that the chief executive of Way To Go Heliservices review the company's internal quality assurance system to ensure that:

- **there are robust systems in place for establishing the actual weight and balance of all company aircraft for all operations**
- **incidents and accidents are recorded, notified to the CAA and investigated, and corrective actions are taken as appropriate**
- **pilots are fully aware of and observe the operating limitations of all the aircraft types and variants that they fly. (016/18)**

On 8 June 2018, Way To Go Helicopters, replied:

> Way To Go confirms that it will implement the final recommendation contained in your letter of 25 May 2018. Way To Go expects the recommendation will be fully implemented by 30 September 2018.

By way of general comment, Way to Go has been progressing towards the implementation of Safety Management Systems and is focussing on risks that impact on safety. In addition, a 'Just Culture' environment has been introduced and embraced by Way To Go over the past few years.

Weight and balance

Way To Go maintains that its weight and balance system was understood and used by pilots on an operational basis. However, Way To Go was working on and has introduced a modification to Aerial Toolbox to include a weight and balance calculation on each daily flight record that is a visual reminder of the operating limitations of the aircraft being flown. This tool is currently in its testing stage and should be ready for full functional use by 30 September 2018.

Incidents and accidents

Way To Go has recently updated the Aircare qualification. This has resulted in modifications and additions to the Quality Assurance system including a Reported Quality Improvement register, clear goals for Internal Audit processes, and requirements for documentation of responsibilities and follow ups from staff and executive meetings. These changes reflect formally documenting the processes Way To Go has always followed.

These changes will be internally audited for effectiveness in the quarter ending 30 September 2018.

Operating limits

Way To Go relies on the annual Flight Competency Check and the six monthly Competency Check for recording Pilot Training of operational limitations of aircraft. Way To Go has always documented these but has now also made recording compulsory of informal Pilot Toolbox and Crew Meetings which will help ensure records can prove Crew Training understanding.

The company is in a change period for Crew Training Manager and is reviewing a Procedural Update for Crew Training along with Risk Assessment documentation. Way To Go is also currently evaluating other procedural changes required to ensure personnel that are trained and competent in safety responsibilities are documenting such fully.

Reporting to TAIC

Way To Go will write again setting out the date when the recommendation was fully implemented, a brief description of how it was implemented and evidence to support its implementation.

Notice of recommendation given to the Director of Civil Aviation

8.5. On 23 May 2018 the Commission gave notice to the Director of Civil Aviation of a recommendation made to the operator, stating that:

The operator did not have adequate systems available for the pilot to determine the actual all-up weight and balance of the helicopter for the firefighting operation, or to ensure that incidents such as the previous loss of a window were recorded, notified to the CAA and investigated. The use of a prohibited door configuration suggested inadequate awareness of and adherence to flight manual limitations, which often differ between otherwise similar variants of an aircraft.

On 23 May 2018 the Commission recommended that the chief executive of Way To Go Heliservices review the company's internal quality assurance system to ensure that:

- there are robust systems in place for establishing the weight and balance of all company aircraft for all operations
- incidents and accidents are reported and investigated, and corrective actions are taken as appropriate
- pilots are fully aware of and observe the operating limitations of all the aircraft types and variants that they fly. (016/18)

9. Key lessons

9.1. Flight in turbulent conditions requires care in order for the pilot to avoid exceeding an aircraft or equipment speed limitation.

9.2. It is important that operators and pilots understand the reasons for and observe the specific limitations applicable to each aircraft that they operate, as variations often exist between different variants of the same aircraft type.

9.3. All operational incidents should be recorded and investigated by the operator so that the causes can be identified and corrective or preventive actions taken.

9.4. Performance-impairing substances such as recreational drugs pose a serious risk to aviation safety. Their short- and long-term effects may be unpredictable and result in pilots being impaired when flying their aircraft.

Appendix 1: Eurocopter Service Letter No. 1727-25-05

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DIFFUSION/ISSUE
AUSGABE/PUBLICATION

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Service à la Clientèle
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Lettre-Service
No. 1727-25-05

Marignane, 30.03.2006

SUBJECT:

EQUIPMENT AND FURNISHINGS: Sling Work

Important: The information contained in this Service-Letter is intended mainly for pilots.

332	B	B1	M	M1	F1	C	C1	L	L1	L2
532	UL	AL	SC	AC	UC	A2	U2	UE		
EC225	LP									
EC725	AP									

350	D	B	B1	B2	B3	BA	BB	L1
550	U2	C2	C3	A2				
355	E	F	F1	F2	N			
555	MN	UN	SN	UF	AF	AN		
EC130	B4							

360	C											
365	C	C1	C2	C3	N	N1	N2	N3	K	F	Fs	Fi
366	G1	Ga										
565	SA	SB	UB	MA	MB	AA						
EC155	B	B1										

EC120	B

321	Ja	Ga	Gb	Gc

330	Sm	Ba	Ea	C	Ca	H	L	F	G	J	S1	JM	B

341	B	C	D	E	F	G	H
342	J	K	L	L1	M	M1	

AL II	3130	313B		
AL II ASTAZOU	3180	318B	318C	
AL III	3160	316B	316C	319B
LAMA	315B			

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Dear Customer,

Sling Work represents a large part of helicopter activity, and is recognized as a difficult mission that requires good pilot skills and procedures, as the accident risk is higher than that of other missions due to its demanding nature.

The purpose of this Service-Letter is not to instruct pilots in sling load operations, but to remind them of some lessons learned from analysis of accidents. EUROCOPTER is not admitting the existence of any duty and/or any liability concerning these accidents, but wishes that observance of the lessons learned leads to a decrease in the risks.

Lessons Learned

Do not take off with an empty bag or net.

Use only bags or nets in a good condition, and reinforce them with strong straps, if necessary.

Unloaded slings, especially, short slings (5 to 10 m), should be ballasted with at least 15 kg at the cargo hook.

When using long slings, assistance of a person on the ground, equipped with a radio, is vital.

Do not operate with only marginal fuel content.

With unloaded slings, avoid descending at airspeeds above Vy, and avoid load factors less than .5g.

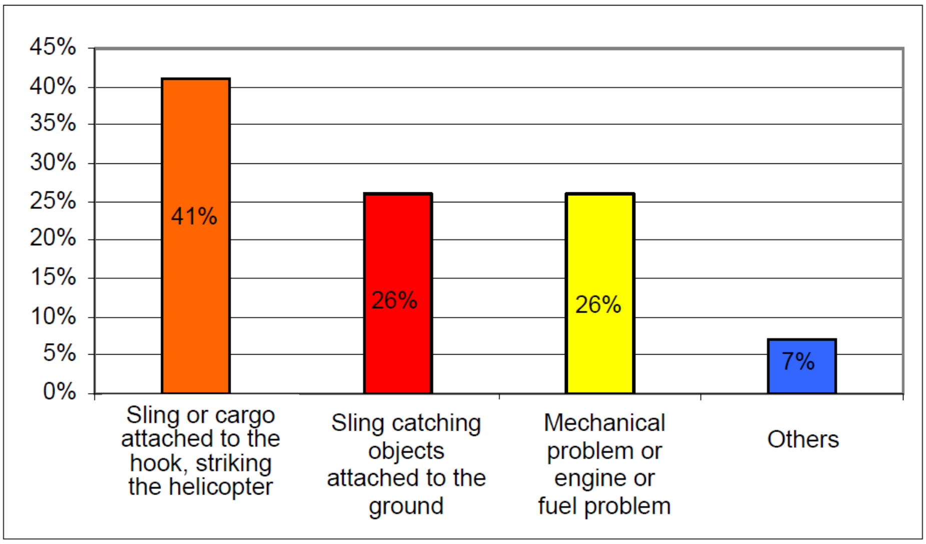
On SA315 LAMA helicopters, comply with the pitch limits. Check for correct calibration, and if components other than EUROCOPTER components (blades, etc.) are installed, check the control rigging and use only the permitted corresponding pitch settings.

1) Accidents reported over the last 6 years:

Type of aircraft:

41%	SA315	LAMA
4%	SA316	ALOUETTE III
55%	AS350	ECUREUIL
0%		DAUPHIN - PUMA - SUPERPUMA

Types of accidents:



2) The causes broken down into 4 categories:

In most of the cases (41%), the sling contacts the tail rotor, which may cause the TGB and parts of the fin to be damaged. The two main reasons are either an abrupt dive maneuver or bursting of the bag which behaves like a parachute when empty. In both cases, the cable and its cargo are subject to airstream loads which prevail over the weight of the cable and cargo. Consequently, the sling or load follows the airstream into the tail rotor area.

The second category includes cases in which the sling becomes entangled with objects on the ground (26%). Most of these cases could have been avoided if there had been a person on the ground to warn the pilot, who cannot see the hook clearly due to the length of the cable. This category also includes cases of slings becoming entangled in aerial lines.

The third category mainly includes LAMA helicopters with several cases of excessive use of collective pitch which, in hot weather or at altitude, causes the engine to surge and can then lead to its destruction (single-shaft engine). In cold weather and at low altitude, repeated torque exceedance can cause damage to the drive train. One LAMA helicopter was involved in an accident due to lack of fuel.

The fourth category includes a dynamite explosion which occurred during a sling operation, and a case of suspected transient control jamming. This event is still under investigation.

3) Solutions

Ballast slings, especially those that are less than 10 m long. The effect is obvious in stabilized flight. During descents at airspeeds above Vy, it is possible for the sling to move upward, even with ballast, at load factors less than .5g. This phenomenon can be avoided by conducting descents at airspeeds below Vy.

Failure of a bag can prove to be dangerous given the significant aerodynamic drag to which the empty bag is exposed. Even with no load factor, the sling and bag can move upward toward the tail rotor. You must use very solid bags which are in a good condition, reinforced with solid straps, if necessary. Consideration may be given to utilizing nets rather than bags when the load will allow this alternative.

REMARK:
In the event of tail rotor contact and loss of control consider the following procedure.
Depending on weight, damage, altitude and airspeed, the suggested procedure will be more or less effective, but may provide the best alternative for this circumstance.
The helicopter will start a quick leftward rotation (rotor rotating clockwise), and even if the pilot did not respond early enough, and the helicopter has already rotated several turns, proceed as follows:
- Select full low pitch.
- Shut down the engine completely
- If possible, establish a speed of 40 kt as soon as the helicopter stops rotating. In case of a loss of the tail fin, the decent will be vertical.
- Down to a height of approx. 200 m above the ground, the situation seems to have become normal, then the sensation of vertical speed will become more and more obvious.
- Start increasing the pitch at a height that is twice the usual height for an autorotation. The touchdown will be hard, but survivable. (High-energy absorbing seats increase the survivability considerably).

Attempts to take off with the sling caught on the ground can be avoided if a person, in radio-contact with the pilot, monitors the operation from the ground. This is vital when the cargo hook is not clearly visible either directly or in the mirror. In addition, it is recommended to avoid aggressive take-offs, and to start with a vertical climb before transition to level flight. Thus, the pilot should become aware of a snag because of the restricted climbing capability.

Sling Work is often carried out in a relatively low fuel state (with a remaining fuel quantity of less than 10%). LAMA helicopters are fitted with a very-low-fuel-level option. This option is not available on AS350 helicopters. For helicopter versions up to version B2 inclusive, when the fuel probe indicator has reached “0”, there are only 2 minutes of flying left, and when the fuel pressure drops to zero, there are only 10 seconds left, until engine flame-out occurs. On helicopter version B3 and EC130 B4 helicopters, these 10 seconds are reduced to zero. Due to the shape of the tanks and the technology of the fuel probes installed on AS350 helicopters, the equipment proves to be accurate since capacitance probes were introduced to service in 1992. However, be more careful with resistance probes. Get used to checking that the indications are consistent with the partial top-ups, and do not wait until there are only a few liters of fuel left.

The single-shaft engine of the LAMA helicopter is an old design and has particular characteristics. Exceeding of thermal power limits may result in surging which subsequently might result in heavy damage of the engine. On engines of more recent design, e.g. ARRIEL engines, any thermal power exceedance just results in NG or T4 exceedance and is harmless if it does not last for more than 5 to 10 seconds and if the limits specified in the Flight Manual are not exceeded.

LAMA helicopters are not equipped with a torquemeter. Consequently, compliance with the power limits is ensured by accurate adjustment and correct determination of the pitch limit. On AS350 B3 helicopters, a pitch error of 0.5° equals 13% of torque. The sum of these errors (e.g. resulting from a pitch error of 0.5° plus an error of 0.5° made by the pilot) in addition to the installation of rotor blades from outside sources not recommended by EUROCOPTER, without taking the corresponding maximum pitch reduction into account may cause the torque limit to be exceeded in the magnitude of 30%,.
In cold weather, with the same pitch, the torque increases. The exceptional performances of the LAMA helicopter hide torque exceedances that may cause damage to the dynamic components.

4) Flight Manual Familiarity

Most of the recommendations noted in this Service-Letter are specified in the various Flight Manuals. For example, refer to:

315 LAMA	SUPP 1
350 B2	SUPP 9.1
350 B3	SUPP 13
EC120 B	SUPP 10.1

We hope that this document assists you in operating your helicopter or fleet safely.

Yours sincerely,

AIRBUS HELICOPTERS

No. 3170-S-00

SAFETY INFORMATION NOTICE

SUBJECT: **GENERAL**

External load operations

For the attention of

AIRCRAFT CONCERNED	Version(s)	
	Civil	Military
EC120	B	
AS350	B, BA, BB, B1, B2, B3, D	L1
AS550		A2, C2, C3, U2
AS355	E, F, F1, F2, N, NP	
AS555		AF, AN, SN, UF, UN, AP
EC130	B4, T2	
SA365 / AS365	C, C1, C2, C3, N, N1, N2, N3	F, Fs, Fi, K, K2
AS565		MA, MB, SA, SB, UB, MBe
SA366		GA
EC155	B, B1	
SA330	J	Ba, L, Jm, S1, Sm
SA341	G	B, C, D, E, F, H
SA342	J	L, L1, M, M1, Ma
ALOUETTE II	313B, 3130, 318B, 318C, 3180	
ALOUETTE III	316B, 316C, 3160, 319B	
LAMA	315B	
EC225	LP	
EC725		AP
AS332	C, C1, L, L1, L2	B, B1, F1, M, M1
AS532		A2, U2, AC, AL, SC, UE, UL
EC175	B	
EC339		KUH/Surion
BO105	C (C23, CB, CB-4, CB-5), D (DB, DBS, DB-4, DBS-4, DBS-5), S (CS, CBS, CBS-4, CBS-5), E-4, LS A-3	CBS-5 KLH
MBB-BK117	A-1, A-3, A-4, B-1, B-2, C-1, C-2, C-2e, D-2, D-2m	D-2m
EC135	T1, T2, T2+, T3, P1, P2, P2+, P3, 635 T1, 635 T2+, 635 T3, 635 P2+, 635 P3	
EC135H	T3H, P3H, 635 T3H, 635 P3H	

Revision 0 2017-06-26
Revision 1 2017-10-03

This document is available on the internet: www.airbushelicopters.com/techpub/

In line with our constant commitment to improving the safety of helicopter operations, Airbus Helicopters would like to share information about some recent accidents which have occurred during sling load operations.
Sling load operation represents a large part of helicopter activity, and is recognized as a difficult mission that requires good pilot skills and stringent procedures, as the accident risk is higher than for other missions due to its demanding nature. The average rate on the worldwide Airbus Helicopters fleet is close to one accident per month.

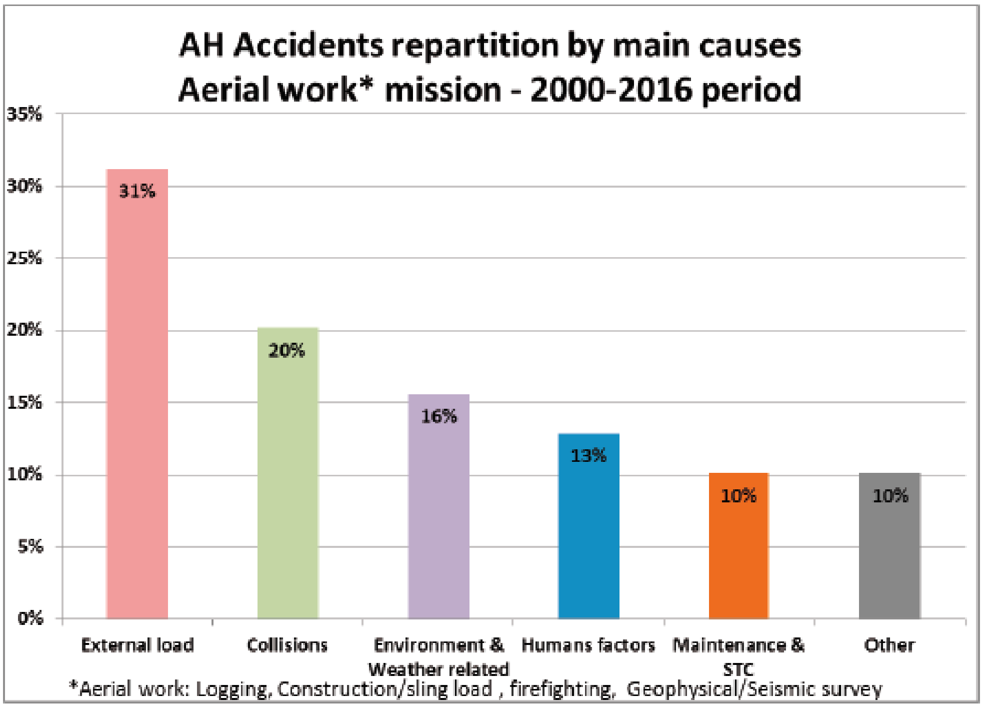
The purpose of this Safety Information Notice is not to instruct pilots and ground teams on sling load operations, but to share with them some lessons learned from analysis of accidents.
This Safety Information Notice replaces Service Letter No.1727-25-05 published on March 26, 2006.

Airbus Helicopters is not admitting the existence of any duty and/or any liability concerning these accidents but wishes that observance of the recommendations listed below leads to a decrease in the risks.

RECOMMENDATIONS

- **Respect limitations published in the Flight Manual including those related to STC in SUP approved Part.**
- **Apply the procedure and respect the limitation provided by sling load items manufacturers and providers.**
- **Strictly adhere to established Standard Operational Procedures (SOP), respect speed limitations with and without the load.**
- **Be aware that a metallic cable has not the same behavior in flight than a synthetic/textile long line.**
- **Each unloaded sling is a potential hazard for the operation. Experience has shown that unloaded slings should be ballasted at the bottom of the line. The ballast at the bottom of the line must be so heavy, that the unloaded sling cannot, according to flight limits and regulations, endanger the helicopter or operation. Minimum weight of 15 kg is recommended, or more depending on the equipment used and the specificity of the operation.**
- **With unloaded slings, avoid descending at airspeeds above Vy, and avoid load factors less than 0.5 g. Maintain visual control on your line (mirror or equivalent).**
- **Use only bags or nets in a good condition, and reinforce them with strong straps, if necessary. Do not take off with an empty bag or net.**
- **Brief systematically with ground team and helpers before conducting the operation.**
- **When using long slings, assistance of a person on the ground equipped with a radio, is highly recommended.**
- **Do not operate with only marginal fuel content.**
- **Always depart vertically with your sling / load to avoid entanglements.**
- **On SA315 LAMA helicopters, comply with the pitch limits. Check for correct calibration. If components other than Airbus Helicopters components (blades, etc.) are installed, check the control rigging and use only the permitted corresponding pitch settings.**

1. **Accidents reported over the last 16 years**



2. **Recommendations**

a. External load

Ballast slings. An unloaded sling is a potential hazard (tail rotor strike) and all slings should be adapted with ballast. The effect is obvious in stabilized flight. During descents at airspeeds above Vy, it is possible for the sling to move upward, even with ballast, at load factors less than 0.5 g. This phenomenon can be prevented by conducting descents at airspeeds below Vy. Be aware of the sling you use (steel or textile). Textile slings can fly very high towards tail rotor with high speed. On the ground, take particular care of the textile line as it can more easily get caught in the tail rotor due to its characteristics.
Whenever possible, land the sling in front of the helicopter so that the line is visible and under the control of the pilot. It is highly recommended to fit a swivel bottom on the rope in any case.

Failure of a bag can prove to be dangerous given the significant aerodynamic drag to which the empty bag is exposed. Even with no load factor, the sling and bag can move upward toward the tail rotor. You must use very solid bags which are in a good condition, reinforced with solid straps, if necessary.

Note:
Some bags are for single usage only and it is difficult for the crew to get this information.
Consideration should be given to the use of nets rather than bags if the load allows this alternative.

b. Collisions

Most of the accidents are caused by the collision with cables or antennas in the vicinity of the sling area or by the collision of the main or tail rotor with obstacles.
A proper recognition of the area before performing the approach is highly recommended.
Some of the collisions with obstacles during the lifting are also caused by a loss of situation awareness, the left side of the aircraft being "forgotten" by the pilot seated in the right seat.

c. Environment/Weather related

Weather conditions can change very rapidly, particularly in mountainous areas. A particular focus should be done during the flight preparation, and a GO/NO GO decision should be made with the ground team before the flight. Do not hesitate to abort an operation when reaching marginal weather conditions such as stormy weather.

Real time performance can be very different from the expected performance calculated during the flight preparation. A variation in atmospheric pressure, outside temperature or wind can have a high impact on the performance of the aircraft.

Sling Work is often carried out with a relatively low fuel state (with a remaining fuel quantity of less than 10%). LAMA helicopters are fitted with a very-low-fuel-level option.
This option is not available on AS350 helicopters. For helicopter versions up to version B2 inclusive, when the fuel probe indicator has reached "0", there are only 2 minutes of flying left, and when the fuel pressure drops to zero, there are only 10 seconds left, until engine flame-out occurs.
On H125 and H130 helicopters, these 10 seconds are reduced to zero. Due to the shape of the tanks and the technology of the fuel probes installed on H125 helicopters, the equipment proves to be accurate since capacitance probes were introduced to service in 1992. However, be more careful with resistance probes. Get used to checking that the indications are consistent with the partial top-ups, and do not wait until there are only a few liters of fuel left.
This technical information is provided to help identifying imminent fuel starvation condition. A safe fuel management should always prevent reaching this state of fuel.

d. Human Factors

This is maybe the most difficult cause to address. A lot of accidents are caused by a lack of coordination and communication between the aircrew and the ground team: helpers injured by debris projected by the rotor downwash, by the movement of the load when lifting or caught on the net on the load, etc.
It is mandatory to brief the operation with the whole team, to review the sequence of operations, to check the radio-communication (use and frequency) and to brief how to react in case of emergency.

Attempts to take off with the sling caught on the ground can be prevented if a person, in radio-contact with the pilot, monitors the operation from the ground. This is vital when the cargo hook is not clearly visible either directly or in the mirror. In addition, it is recommended to avoid aggressive take-offs, and to start with a vertical climb before transition to level flight. The pilot should thus become aware of a snag because of restricted climbing capability.

e. Maintenance

A lot of accidents are caused by errors during aircraft preparation or maintenance, mainly due to task interruption or operations that are conducted without following the OEM Technical instructions. A properly maintained and airworthy aircraft is mandatory to perform a safe and reliable flight.

f. Suitability of flight operations equipment, operator competence and expert knowledge

Choice and sourcing of equipment

The choice (procurement) of suitable lifting accessories and slinging equipment, their correct use and the adoption of appropriate techniques for the slinging of loads are fundamental safety criteria for helicopter external sling load operations (HESLO).

It is in the nature of things that the operation of helicopters is subject to particular requirements and involves special risks; therefore, it is crucial that users apply expert knowledge regarding the suitability and correct use of lifting accessories and slinging equipment.

In the EASA area, Operators are responsible for the sourcing of suitable lifting accessories and slinging equipment as well as for maintaining their serviceability. See ED Decision 2014/018/R, Annex VIII Part-SPO, AMC1 SPO.SPEC.HESLO.100 (c)(3)

When sourcing their equipment, users must inform the manufacturers or the distributors (retailers) of the special requirements the equipment must be able to fulfill.

All lifting accessories and slinging equipment must be state of the art and in conformity with legal prescriptions. Moreover, all work equipment must be assessed and tested with regard to its suitability (risk analysis). Instructions for use and maintenance (user guide) are an integral part of the product.

Training and occupational safety

All task specialists must undergo initial and recurrent training regarding the appropriate use of work equipment, the special requirements and the assessment criteria for its withdrawal from service. Maintenance procedures and permissible repairs must only be carried out by qualified persons (trained by the equipment manufacturer).

In the EASA area, the legal framework for initial and recurrent training is ED Decision 2014/018/R, Annex VIII Part-SPO, AMC1 SPO.SPEC.HESLO.100

Each user should comply with national law on occupational safety.
EU: *Directive 2009/104/EC concerning the minimum safety and health requirements for the use of work equipment by workers at work.*

Manufacturer/distributor

All manufacturers and/or distributors (retailers) must have expert knowledge of the particular requirements and risks to which lifting accessories and slinging equipment are exposed during helicopter external sling load operations. During the development, design and construction phase as well as when supplying equipment, the manufacturers/distributors must guarantee the suitability and the safe use of the latter.

Special attention must be paid to the choice of raw material and specific calculations (service strength, minimum breaking load, service life and life span in general). Compared to normal industrial use, the equipment employed during helicopter operations must be able to withstand different forces (such as bank angle, G-force, drag, shock loads, angles of inclination, downwash but also wear due to UV rays or heavy workload). All these factors must therefore be considered.
When caused by inappropriate lifting accessories and/or slinging equipment, even the loss of one single part of an external load can entail considerable criminal proceedings for both the helicopter operator and the manufacturer.

In Europe, EC Machinery Directive 2006/42/EC is the standard for the manufacture of "lifting accessories" (art. 1.d, art. 2.d) (ropes, traverses), as well as "slings and their components" (art. 2.d) (round slings, lifting straps, slinging chains, multiple-leg slings, shackles, etc.).

Manufacturers should not rely on the assumption that safety factors 4 (steel), 5 (steel ropes) or 7 (textiles, see Machinery Directive 2006/42/EC, annex I, art. 4.1.2.5) are sufficient for the particular operational and material requirements of helicopter external load operations.

Note: the safety factors given in Machinery Directive 2006/42/EC, annex I, art. 4.1.2.5, are only reference values and the actual values may therefore be higher. It is the manufacturers' duty to assess the actual requirements together with their customers and subsequently define the factors actually needed. The specifications for a sling which will only be used to transport a specific machine (and nothing else), for example, cannot be compared to the requirements of a Logging Long Line.

Links
- EC 2009/104/EC: http://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32009L0104
- EC 2006/42/EC: http://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX%3A32006L0042
- EASA Part SPO: https://www.easa.europa.eu/document-library/agency-decisions/ed-decision-2014018r
- EASA CS-27: https://www.easa.europa.eu/certification-specifications/cs-27-small-rotorcraft
- EASA CS-29: https://www.easa.europa.eu/certification-specifications/cs-29-large-rotorcraft

Miscellaneous publications
- CH: Marshaller Syllabus, FOCA 1996 (FH-SY, available in German, French, Italian, English), https://www.bazl.admin.ch/bazl/en/home/specialists/air-transport/operation/helicopter-companies/commercial-flight-operators/spo.html
- CH: Neuf règles vitales pour le personnel au sol des aires de manœuvre d'hélicoptères, SUVA 2014 (available in German, French, Italian) https://www.suva.ch/de-ch/praevention/sicherheit-mit-system/lebenswichtige-regeln#uxlibrary-material=a13b1de0050fd3482b025df264d5c59c&uxlibrary-safetyrules=5d33fd5f7837496bbc436c2278138a80
- DE: DGUV Information: 214/911 "Safe Helicopter External Load Operations" (available only in German) www.bg-verkehr.de

Airbus Helicopters thanks Patrick Fauchère, Air Glaciers Flight Ops Manager and Enrico Ragoni, CEO at AirWork & Heliseilerei GmbH for their wise support to issue this Safety Information Notice.

Recent Aviation Occurrence Reports published by the Transport Accident Investigation Commission (most recent at top of list)

Interim Report AO-2017-004	Forced landing into Porirua Harbour (Pauatahanui Arm), MBB BK117A-3 Helicopter, ZK-IED, 2 May 2017
Interim AO-2017-009 and AO-2017-010	AO-2017-009: Boeing 787-9, registration ZK-NZE, Trent 1000-J2 engine failure near Auckland, 5 December 2017; and AO-2017-010: Boeing 787-9, registration ZK-NZF, Trent 1000-J2 engine failure, near Auckland, 6 December 2017
AO-2016-006	Eurocopter AS350-B2, ZK-HYY, Collision with terrain during scenic flight, Mount Sale, near Arrowtown, 12 September 2016
AO-2015-003	Robinson R44, Main rotor blade failure, Waikaia, Southland, 23 January 2015
AO-2014-005	Eurocopter AS350-B2 (ZK-HYO), collision with terrain, during heli-skiing flight, Mount Alta, near Mount Aspiring National Park, 16 August 2014
AO-2015-005	Unplanned interruption to national air traffic control services, 23 June 2015
AO-2016-004	Guimbal Cabri G2, ZK-IIH, In-flight fire, near Rotorua Aerodrome, 15 April 2016
AO-2015-001	Pacific Aerospace Limited 750XL, ZK-SDT, Engine failure, Lake Taupō, 7 January 2015
AO-2013-010	Aérospatiale AS350B2 'Squirrel', ZK-IMJ, collision with parked helicopter, near Mount Tyndall, Otago, 28 October 2013
Addendum to final report AO-2015-002	Mast bump and in-flight break-up, Robinson R44, ZK-IPY, Lochy River, near Queenstown, 19 February 2015
Interim Report AO-2017-001	Collision with terrain, Eurocopter AS350-BA, ZK-HKW, Port Hills, Christchurch, 14 February 2017
AO-2013-011	Runway excursion, British Aerospace Jetstream 32, ZK-VAH, Auckland Airport, 2 November 2013
AO-2014-006	Robinson R44 II, ZK-HBQ, mast-bump and in-flight break-up, Kahurangi National Park, 7 October 2014
Interim Report AO-2016-007	Collision with terrain, Robinson R44, ZK-HTH, Glenbervie Forest, Northland, 31 October 2016
AO-2014-004	Piper PA32-300, ZK-DOJ, Collision with terrain, Near Poolburn Reservoir, Central Otago, 5 August 2014

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