Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Report – 200606570

Final

Aircraft loss of control - Palmers Island, NSW
2 November 2006
VH-AAL
Bell Helicopter Company 206A

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Figure 1 satellite image of accident location overlaid with GPS track courtesy of Google Earth

Abstract

On 2 November 2006, the pilot of a Bell Helicopter Company 206A helicopter, registered VH-AAL, departed Coffs Harbour, NSW, on a private flight to a property located at Palmers Island, near Yamba, NSW. On board the 206A were the pilot and one passenger in the front left seat.

On arrival in the vicinity of Palmers Island, the pilot commenced a downwind turn into a strong quartering tailwind and the helicopter began an uncommanded right yaw. The pilot attempted to regain control, but the helicopter continued to yaw and to descend until it impacted the ground. The pilot and passenger sustained serious injuries and the helicopter was destroyed.

There was no evidence found of any mechanical or systems failures that may have contributed to the accident. The reported local conditions and nature of the loss of control were consistent with a loss of tail rotor effectiveness (generally referred to as LTE).

While a serviceable emergency locator transmitter was fitted to the helicopter, it had not been ‘armed’ prior to the flight and did not activate as a result of the impact.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the Transport Safety Investigation Act 2003 and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

FACTUAL INFORMATION

History of the flight

On 2 November 2006, at 1515 Eastern Daylight-saving Time[1], the owner-pilot of a Bell Helicopter Company 206A (Jetranger) helicopter, registered VH-AAL, departed Coffs Harbour, NSW, on a private flight to a property located at Palmers Island, near Yamba, NSW. Also on board was a passenger occupying the front left seat.

The flight was operated under the visual flight rules (VFR) and at about 1604, the pilot approached the intended landing site from the south-west on descent from an altitude of 500 ft. The pilot had intended to overfly a farmhouse located on the property to visually check for landing obstructions before landing in a cleared paddock adjacent to the house.

As the helicopter passed to the east of the house at a height of between 100 and 200 ft, the pilot commenced a banked turn to the left (Figure 1). The pilot later reported that as he was completing the turn onto a southerly heading, the helicopter suddenly and unexpectedly 'threw around' (yawed[2]) to face back in the opposite direction. He reported that he applied opposite tail rotor pedal to correct the situation and that the helicopter responded and turned back towards the south. At this point, the helicopter once again 'flicked' back sharply in the opposite direction, but then continued in an uncommanded yaw. Further attempts by the pilot to control the yaw by application of opposite tail rotor pedal were ineffective and the helicopter continued to yaw and to descend until it impacted the ground in the landing site paddock. The pilot later reported that when the helicopter had begun to yaw, he believed that the tail rotor had failed. While he had continued to apply tail rotor pedal inputs, his main concentration had then been on trying to keep the helicopter level. He also recalled raising the collective lever[3] during the accident sequence in an attempt to arrest the descent rate.

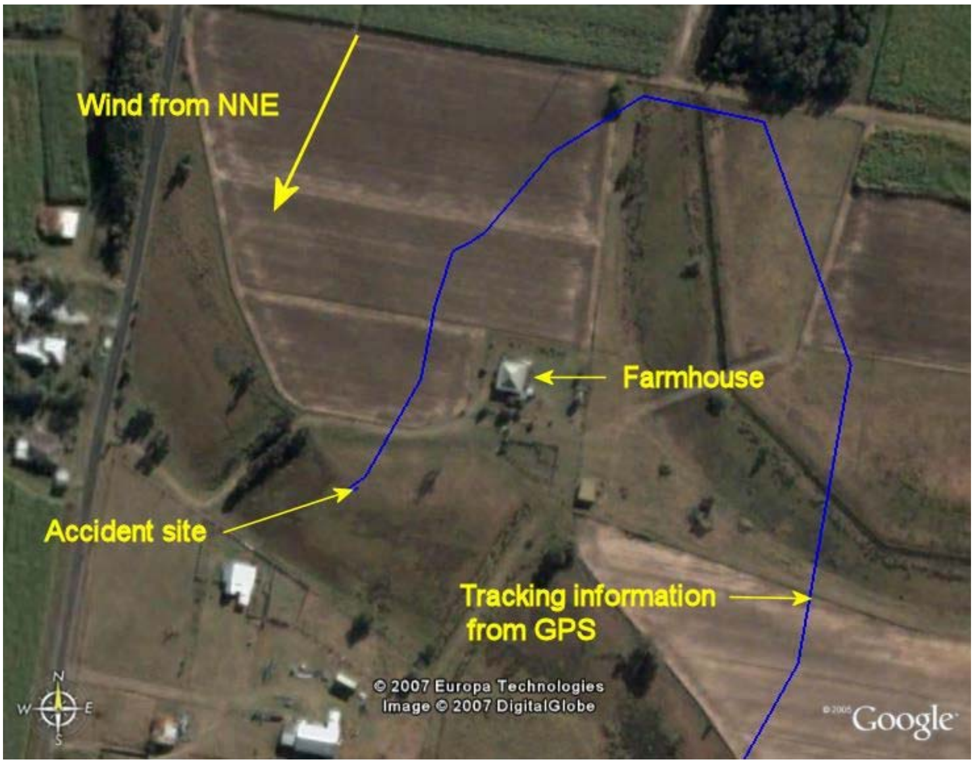
The pilot and passenger sustained serious injuries and the helicopter was destroyed by the impact forces. Several witnesses were able to reach the accident site within minutes and assisted the pilot and passenger from the wreckage. The witnesses reported later that the engine was still operating when they arrived at the accident site and continued to operate for several minutes before they were able to shut it down. By 1608, other witnesses had contacted the emergency services and police and ambulance personnel arrived at the scene a short time later. Ambulance officers treated and stabilised the two occupants at the scene before transferring them to hospital.

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Daylight-saving Time (ESuT), as particular events occurred. Eastern Daylight-saving Time was Coordinated Universal Time (UTC) + 11 hours.

2 Rotation of the helicopter about its vertical axis.

3 The collective lever is the pilot control in helicopters that simultaneously directly affects the pitch of all main rotor blades, irrespective of their azimuth position. It is the primary control of a helicopter's altitude or vertical velocity.

Figure 1: Helicopter GPS track data overlaid on satellite image



GPS and witness information

A portable global positioning system (GPS) unit was recovered from the helicopter wreckage and the tracking information was successfully downloaded. The GPS tracking information showed that the pilot initially approached the intended landing site from the south south-west into a head wind of about 25 to 30 kts. The pilot later recalled his indicated airspeed to be approximately 65 to 70 kts at that time. After passing abeam the farmhouse, he commenced a 180 degree left turn onto a downwind heading. The radius of that turn was later calculated to be approximately 105 m. As the pilot was completing the turn, it placed the helicopter into a strong quartering tail wind, and it was at this point that both the pilot and a number of witnesses on the ground reported that the helicopter commenced the uncontrolled yaw.

The witnesses had observed the helicopter arrive over the house and commence what they described as a 'steep' banked turn. They reported that the helicopter then continued to turn or rotate (yaw) in a 'flat' motion while also continuing to descend slowly. While the recollection of the number of rotations and direction of yaw varied among witnesses, it was considered that somewhere between 5 and 9 rotations to the right (clockwise) may have been completed. All witnesses provided consistent reports of a relatively stable rotation and descent before a heavy impact was heard and observed.

Helicopter information

The Bell 206A Jetranger helicopter, serial number 606, was manufactured in 1970 and first registered in Australia on 21 December 1970. In 1984, the original 317 shaft horsepower Allison 250 – C18 engine was replaced by a 400-shaft horsepower Rolls Royce Allison 250 - C20 turbine engine. That engine was the same as that fitted to the later model Bell 206B Jetranger II helicopter.

The helicopter had been maintained in accordance with the required maintenance instructions and had a current and valid, maintenance release. There were no defects recorded on the maintenance release at the time of the accident.

The helicopter was not equipped with dual flight controls. It was fitted with a 'Max Extender' which allowed an additional 78 litres (l) of fuel to be carried, for a total capacity of 360 l. The helicopter had been refuelled to this maximum capacity prior to departure from Coffs Harbour. The empty weight of the helicopter was documented as 832.5 kg and the stated maximum take-off weight (MTOW) was 1,451.5 kg.

Because of heavy rain at the wreckage site after the accident, a number of items had been removed from the site for safe-keeping by the police and rescue personnel. Most of the other baggage and equipment was soaked in water and/or spilt fuel. However, a reasonable calculation of the dry weight and loading of this baggage, together with the remaining fuel and weight of the occupants was able to be made. Based on this information, subsequent weight and balance calculations showed that the helicopter was below the MTOW and within the required centre of gravity envelope limits at all times during the accident flight.

Personnel information

The pilot's log book was not able to be recovered from the helicopter wreckage. However, the pilot reported that he had held a Private Pilot Licence (PPL) (Aeroplane) for about 28 years and had accumulated about 2,500 hours, mainly on fixed-wing single-engine aircraft. He had obtained a PPL (Helicopter) together with an endorsement on a single piston-engine helicopter about 3 years before the accident and reported about 900 hours flying time in that type of helicopter. He subsequently purchased and obtained an endorsement on the accident helicopter, a turbine-engine Jetranger, which he had flown for almost 200 hours.

The pilot reported that he had not flown at all in the 2 weeks preceding the day of the accident, that he had maintained a normal work and rest schedule during this period, and that he had been medically fit. On the morning of the accident, he had submitted visual flight rules flight plans and obtained a verbal weather briefing from Airservices Australia. After completing a pre-flight inspection, he departed from his home at about 1005, for a short flight to the Gold Coast Airport, Qld to refuel the helicopter and to pick up the passenger.

The purpose of the flight was for the passenger to conduct a pre-purchase inspection of business equipment owned by the pilot. The passenger held a PPL (Aeroplane) and Commercial Pilot Licence (CPL) (Helicopter). After departing from the Gold Coast Airport at 1045, they travelled to Grafton and Coffs Harbour, intending to return to the Gold Coast Airport via Palmers Island. The purpose of the landing at Palmers Island was for the pilot to pick up another passenger. The passenger waiting on the ground also held a PPL (Aeroplane) and observed the helicopter arrival and the accident sequence.

Meteorology information

The Bureau of Meteorology had prepared aviation and general public forecasts for the region surrounding the accident site. The wind at 2,000 ft above mean sea level was forecast to be from the north at 25 kts and there was also a strong wind warning current for the local area. The cloud was forecast to be scattered[4], and sometimes locally broken, cumuliform cloud with a base of 3,000 ft.

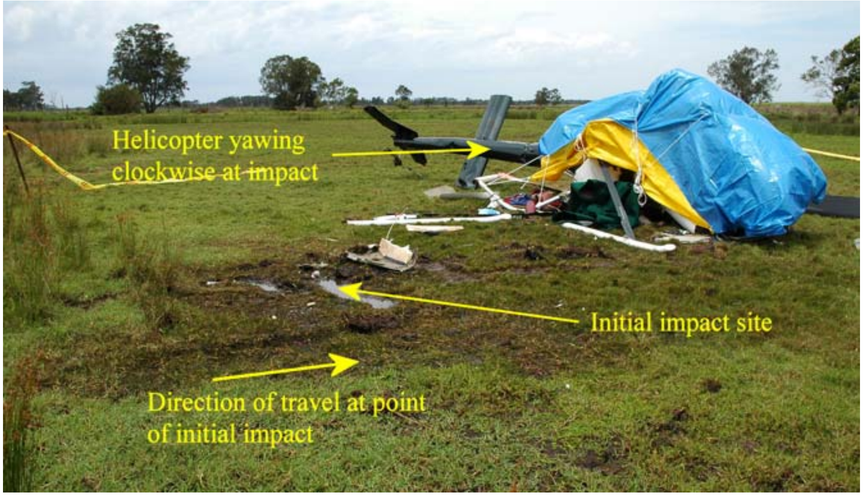
At 1500, a weather observation from Yamba, located 7 km east of Palmers Island, recorded the wind as being from the north-north-east at 15 kts with 5 oktas of cloud. At 1600, the Evans Head automatic weather station, located 28 km north north-east of Palmers Island, recorded the wind as 020 degrees at 17 kts gusting to 26 kts. The temperature was recorded as 22 degrees Celsius and the atmospheric pressure was 1013 hectopascals. Witness reports of weather conditions in the area at the time of the accident were consistent with the forecasts, with most stating the wind was 'blustery' or 'gusty' coming from the north or north-east at between 20 and 30 kts. Cloud was estimated to have been about 4 oktas with a high base and the visibility was reported as good.

The pilot of the helicopter had been aware of a strong headwind on the flight from Coffs Harbour and had contacted the passenger waiting on the ground to advise he would be late because of the headwind. He also later recalled that, on arrival at Palmers Island, he estimated the wind speed to have been about 25 to 30 kts.

Wreckage and impact information

The helicopter impacted the terrain in an approximately 20 to 25 degrees nose-down attitude while banked about 10 degrees to the left, but rotating to the right (clockwise). The wreckage then bounced after impact and continued forward approximately 3.5 m, still rotating to the right, before coming to rest on its left side, about 90 degrees offset to the direction of the initial impact (Figure 2).

Figure 2: Initial impact marks



4 Cloud amounts are reported in oktas. An okta is a unit of sky area equal to one-eighth of total sky visible to the celestial horizon. Few = 1 to 2 oktas, scattered = 3 to 4 oktas, broken = 5 to 7 oktas and overcast = 8 oktas.

Impact damage to the skid landing gear and the forward left underside of the helicopter fuselage indicated high vertical impact forces. This resulted in the severing of the lower aft fuselage and damage to the fuel cell located immediately above. There was also forward (straight-line) compression damage to the tail boom which indicated that the horizontal forces were also high at impact.

Figure 3: Helicopter wreckage

Ground marks showed that a main rotor blade struck the ground after the initial fuselage impact, but before the helicopter came to rest on the left side. This contact caused the blade to separate immediately outboard of the laminated grip section. The separated blade sections showed clear evidence of impact overload and there was no evidence of fatigue cracking, corrosion or any pre-existing damage. The second main rotor blade remained attached to the rotor head. The ground impact marks for this blade showed that it came into contact with the ground along almost the full length of the blade leading edge as the helicopter was coming to rest on its side. It exhibited little impact damage.

The main rotor transmission drive shaft (short shaft) between the engine and main rotor transmission had separated due to torque (twisting) overloads applied after the main rotor blades came into contact with the ground. The couplings at each end of the short shaft showed extensive damage consistent with stoppage while under power.

Ground marks also showed that the tail rotor blades had contacted the ground in three separate locations during the impact sequence as the helicopter was rotating to the right. One of the blades had separated about mid-span and was thrown 27 m from the impact point. The other blade was badly damaged due to impact overloads but remained attached to the tail rotor gearbox. The type and degree of rotational damage to both blades demonstrated that there was significant drive power to the tail rotor when the blades contacted the ground. The first segment of the tail rotor drive shaft, outboard of the main rotor transmission, had separated completely due to torsional overloads. The last segment prior to the tail rotor gearbox also showed evidence of torsional overload.

Examination of the engine controls confirmed continuity. There was no evidence to indicate that the controls would have been restricted in any way prior to impact with the terrain. Witness reports, together with scorch marks on the ground from the engine exhaust, confirmed that the engine continued to operate for several minutes after impact. There was no evidence of any in-flight or post-impact fire.

Examination of all the flight controls systems showed no evidence of any pre-existing damage, or restriction prior to impact and continuity was confirmed for the cyclic and collective control systems. The control tube for the pilot's tail rotor control (anti-torque) system had separated immediately aft of the cockpit area. This separation was due to impact damage to the underside of the fuselage at that location, and the broken section of control rod showed evidence of impact overload. There was no evidence of pre-existing damage or corrosion.

There was no evidence of any pre-existing anomaly with the helicopter that would have contributed to the development of the occurrence. There was also no evidence of any other damage to the helicopter, such as from a bird or wire strike.

Injuries to persons

When witnesses reached the helicopter, the pilot was reported to be in a conscious but 'stunned' condition and in severe pain. He had been restrained by his seatbelt and shoulder harness and had remained strapped to his seat. Later examination showed no evident damage to any part of the pilot's restraint system. The pilot assisted the rescuers to shut the engine down and they released him from the belt and shoulder harness and carried him clear of the wreckage. The pilot had suffered severe back injuries.

The degree of damage to the forward left (passenger) side of the cabin, including the roof and underfloor structure, indicated that both the vertical and horizontal forces to this area during the impact were significant. The passenger had been wearing his seatbelt and shoulder harness which was reported to be securely tightened. However, the seat belt and shoulder harness did not restrain him during the impact sequence, and he was forced downward and forward by deceleration forces. Rescuers reported finding him in an unconscious state 'jammed' into the area under the instrument panel of the helicopter. They had to partially lift the helicopter in order to be able to free him and reported that he was not restrained in any way by a seatbelt or harness at that time. While they were concerned about the risks in moving him (and the pilot), they reported that they had a greater concern about the risk of a fire, especially as both the passenger and the accident site were soaked in spilt fuel. Although the helicopter did not catch fire, the passenger received severe skin burns from contact with the fuel, as well as severe head and back injuries.

No evidence was found to indicate a material failure of the passenger's safety harness webbing, attachment points or centre connect/disconnect buckle. The on-site examination showed that all sections of the safety harness were connected at the four-point centre buckle. The shoulder harness section was found intact and connected to the retraction mechanism. The lower right lap section of the harness was still attached to the fuselage anchor point. The lower left (door side) portion of the passengers lap seatbelt remained anchored at the fuselage attachment point. The mid-section of this belt had pulled completely out of the adjustment buckle and was found separate from the other section of the lap belt. There was no visible evidence of any damage to the webbing, the sewn end of the belt or the buckle adjuster bar. The helicopter manufacturer later advised that the loose end of that belt was always sewn together and was usually 3 times thicker than the webbing. The manufacturer considered that it would be extremely unlikely to be able to pull the thick end of the belt past the buckle adjuster bar.

The harness had a design rating of 1,500 lbs (680 kg). Independent testing of the lower left section of the passenger's belt and buckle was conducted and the results demonstrated, that when correctly fitted, a force of 1,855 lbs (841 kg) was required before the belt webbing failed with only minor slippage of the belt through the buckle observed.

Loss of Tail Rotor Effectiveness (LTE)

A number of documents have been published relating to the unanticipated yaw or loss of tail rotor effectiveness (LTE) in helicopters. A US Federal Aviation Administration (FAA) Advisory Circular AC 90-95 explains that 'LTE is a critical, low-speed aerodynamic flight characteristic which can result in an uncommanded rapid yaw rate which does not subside of its own accord and, if not corrected, can result in the loss of aircraft control'.

Loss of tail rotor effectiveness has been identified as a contributing factor in a number of helicopter accidents both overseas and within Australia[5]. United States Army testing of OH-58 (Kiowa) helicopters, which were developed from the civil B206A Jetranger, identified that LTE could be encountered at high power under certain low-speed manoeuvres and wind conditions. The US National Transportation Safety Board (NTSB) identified that in most cases, inappropriate or late corrective action may have resulted in the development of uncontrollable yaw. It also noted that those mishaps had occurred in the low-altitude, low-airspeed flight regime while manoeuvring or on final approach to a landing.

The FAA publication *Rotorcraft Flying Handbook* explained that:

> LTE is not related to an equipment or maintenance malfunction and may occur in all single-rotor helicopters at airspeeds less than 30 kts. It is the result of the tail rotor not providing adequate thrust to maintain directional control, and is usually caused by either certain wind azimuths (directions) while hovering, or by an insufficient tail rotor thrust for a given power setting at higher altitudes.

The Handbook also discussed various factors that may lead to the onset of LTE, including:

- the impact on tail rotor performance of certain wind azimuths (directions) while hovering
- main rotor vortex interference with the tail rotor
- tail rotor vortex ring state (related to airflow disruption over the tail rotor)

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5 Examples include ATSB investigations BO/200600738 and BO/200003293 which are available at www.atsb.gov.au.

- helicopter weathercock stability[6].

The FAA AC 90-95 described the conditions under which LTE can occur. Included among those conditions were:

- high all up weight
- out of ground effect (OGE) hover
- low forward airspeed
- high power settings
- wind direction from the left or rear of the helicopter.

The FAA AC 90-95 also recommended the following recovery techniques:

> *a. If a sudden unanticipated right yaw occurs,* the pilot should perform the following:
>
> (1) Apply full left pedal. Simultaneously, move cyclic forward to increase speed. If altitude permits, reduce power.
>
> (2) As recovery is effected, adjust controls for normal forward flight.
>
> *b. Collective pitch reduction* will aid in arresting the yaw rate but may cause an increase in the rate of descent. Any large, rapid increase in collective to prevent ground or obstacle contact may further increase the yaw rate and decrease rotor rpm.
>
> *c. The amount of collective reduction* should be based on the height above obstructions or surface, gross weight of the aircraft, and the existing atmospheric conditions.
>
> *d. If the rotation cannot be stopped* and ground contact is imminent, an autorotation may be the best course of action. The pilot should maintain full left pedal until rotation stops, then adjust to maintain heading.

Bell Helicopter operations safety notice

On 31 October 1983, the helicopter manufacturer issued Operations Safety Notice (OSN) 206-83-10 that was directed to operators of various helicopter types including the Bell 206A and 206B. The subject of this notice was titled *Supplemental Operating and Emergency Procedures*. A copy of this notice was contained in the aircraft flight manual retrieved from the helicopter wreckage. The OSN advised that:

> Recent flight testing has revealed that there is a remote possibility that an unanticipated right yaw may occur under certain conditions not related to a mechanical malfunction. These conditions may include high power demand situations while hovering, and/or when relative wind affects airspeed versus ground speed. The purpose of this OSN is:
>
> 1. to emphasise the importance of staying aware of power and wind conditions.

6 Weathercock stability refers to the basic directional stability of the helicopter. ‘Weathercocking’ is the helicopter’s tendency to align its longitudinal axis with the relative wind.

2. to provide a wind azimuth chart.

3. to recommend a technique for recovery from an unanticipated yaw.

Maintain main rotor RPM with the green arc. Note: If main rotor RPM is allowed to decrease the anti-torque thrust required to balance this change increases.

When manoeuvring between hover and 30 mph:

- Be aware that a tail wind will reduce relative wind speed if a down wind translation occurs. If loss of translational lift occurs it can result in a high power demand and an additional anti-torque requirement.

- Be alert during hover (especially OGE) and high power demand situations such as low speed downwind turns.

- Be aware that if a considerable amount of left pedal is being maintained, that a sufficient amount of left pedal may not be available to counteract an unanticipated right yaw.

Observe the relative wind conditions set out in the attached chart.

If a sudden unanticipated right yaw occurs the recommended recovery technique is:

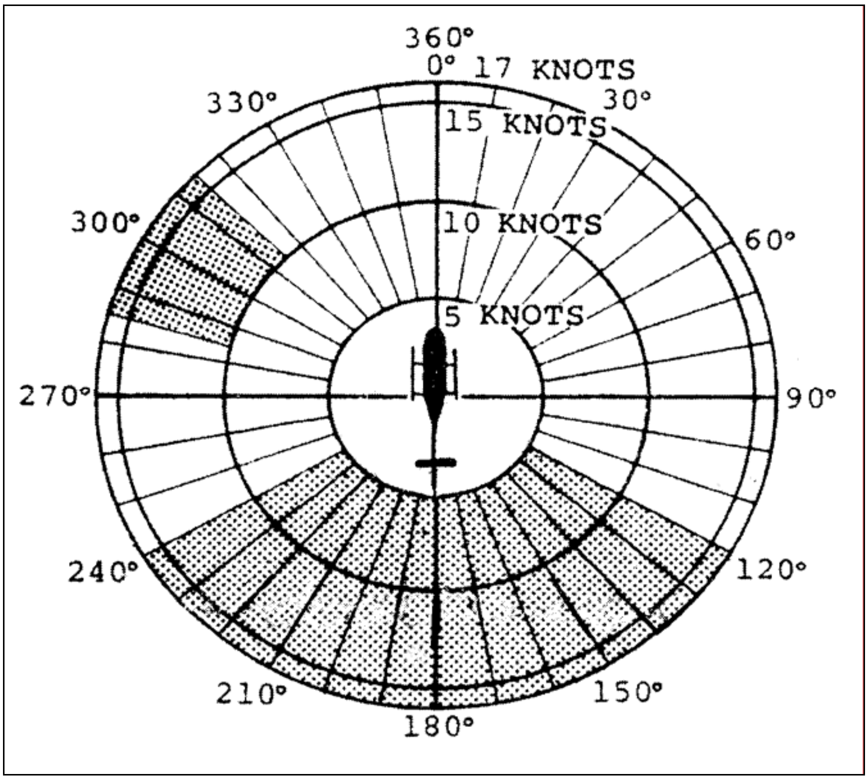
1. Apply full left pedal.

2. Apply forward cyclic, and recover.

3. If altitude permits, reduce power.

Note: The tail rotor is continuing to provide thrust. The time to arrest the yaw rate depends on the magnitude of the yaw rate to be overcome.

Relative Wind Chart



Note: An unanticipated right yaw may occur when operating in the shaded areas of the chart.

Note: This chart refers to unanticipated right yaw and does not replace the critical relative wind azimuth chart in the performance section of the flight manual which refers to tail rotor control margin.

Emergency Locator Transmitter

Australian Civil Aviation Regulation (CAR) 252A refers to emergency locator transmitters (ELT). In part it specified:

> The pilot in command of an Australian aircraft that is not an exempted aircraft, may begin a flight only if the aircraft:
>
> (a) is fitted with an approved ELT:
>
> (i) that is in working order; and
>
> (ii) whose switch is set to the position marked "armed", if that switch has a position so marked

Civil Aviation Advisory Publication (CAAP) 252A-1 (0) titled *Installation of emergency locator transmitters (ELT)* provided guidance for compliance with CAR 252A. In a section referring to ELT remote controls it stated:

> ELT remote controls should be located in view of and accessible from the pilot's normal seated position.
>
> ELT remote controls should enable selection of at least the following functions:

- MANUAL ON – Transmitter manually selected ON.
- ARMED – Transmitter enabled such that activation will occur in response to a correct crash sensor input. ELT must be in this position during flight.
- RESET – Operating Transmitter deactivated and returned to the ARMED condition.

Note: The OFF function should not be available at the remote control.

There was an approved ELT and remote control fitted to the helicopter at the time of the accident. However, the ELT did not activate as a result of the impact. Examination of the helicopter wreckage determined that the ELT was not selected in the ARMED position and was switched OFF at the ELT. The pilot later reported that he did not normally arm the ELT if he considered that he would have continuous radio communications coverage and people would be waiting at his destination for his arrival. He had therefore left it selected in the OFF position for the accident flight.

ANALYSIS

There was no evidence found to indicate that there was a pre-existing defect or mechanical fault with any of the helicopter's flight or engine controls at the time of the accident. It was determined that the engine was developing significant power at the time of the impact and there was also evidence of drive power to the main and tail rotor drive systems.

Information derived from the global positioning system (GPS) unit, together with meteorological information and pilot and witness reports, indicated that the pilot commenced a left banked downwind turn into a strong and gusting quartering tailwind of about 25 to 30 kts immediately prior to the loss of control. As the pilot commenced that turn, he exposed the helicopter to, firstly, a right crosswind, then the quartering tail wind. Flying at low airspeed and operating out of ground effect, the helicopter was in a situation that may lead to an uncommanded right yaw or loss of tail rotor effectiveness (LTE) as described in both the US Federal Aviation Administration (FAA) Advisory Circular AC 90-95 and the Bell Operations Safety Notice (OSN) 206-83-10.

The pilot did not recognise that the local and operational conditions had the potential to induce LTE nor did he recognise its onset, believing instead that there was a mechanical failure. Given this, the pilot most likely did not implement the appropriate recovery techniques to counteract the situation as recommended by both the FAA and the manufacturer, although there may have been insufficient time and altitude in any event. His action in increasing the collective may also have increased the yaw rate and decreased the rotor RPM as described in AC 90-95.

The on-site evidence indicated that the lower left section of the passenger's seat belt may have pulled completely through, and clear of, the self-tightening buckle adjuster bar during the accident sequence, allowing the passenger to 'submarine' downwards and out of the restraint. However, there was no evidence of damage to the webbing or buckle consistent with the belt being forced past the buckle adjuster bar that would have been expected if it had been correctly installed. Independent testing of this section of the harness assembly demonstrated that when correctly fitted the assembly exceeded its published design rating.

As the pilot and passenger both reported that the passenger's harness was securely fastened, the investigation was unable to determine the reason for that section of belt becoming loose.

While there was a serviceable emergency locator transmitter (ELT) fitted to the helicopter, this had not been armed, and therefore did not activate as a result of the accident. While the emergency response to this accident was prompt as a result of the actions of several witnesses, had the accident occurred in a remote location or at a time when no witnesses were present, there may have been a delay in search and rescue, and in the subsequent provision of medical attention to the pilot and passenger.

The accident highlights the importance of the carriage and correct operation of an ELT for all flights.

FINDINGS

Contributing safety factors

- The pilot did not identify that the local and operational conditions existing at the time of the accident had the potential to induce an uncommanded right yaw or loss of tail rotor effectiveness (LTE).
- The pilot did not recognise the onset of LTE and most likely did not implement the appropriate recovery techniques.

Other key findings

- The serviceable emergency locator transmitter fitted to the helicopter had not been armed and therefore did not activate as a result of the accident.