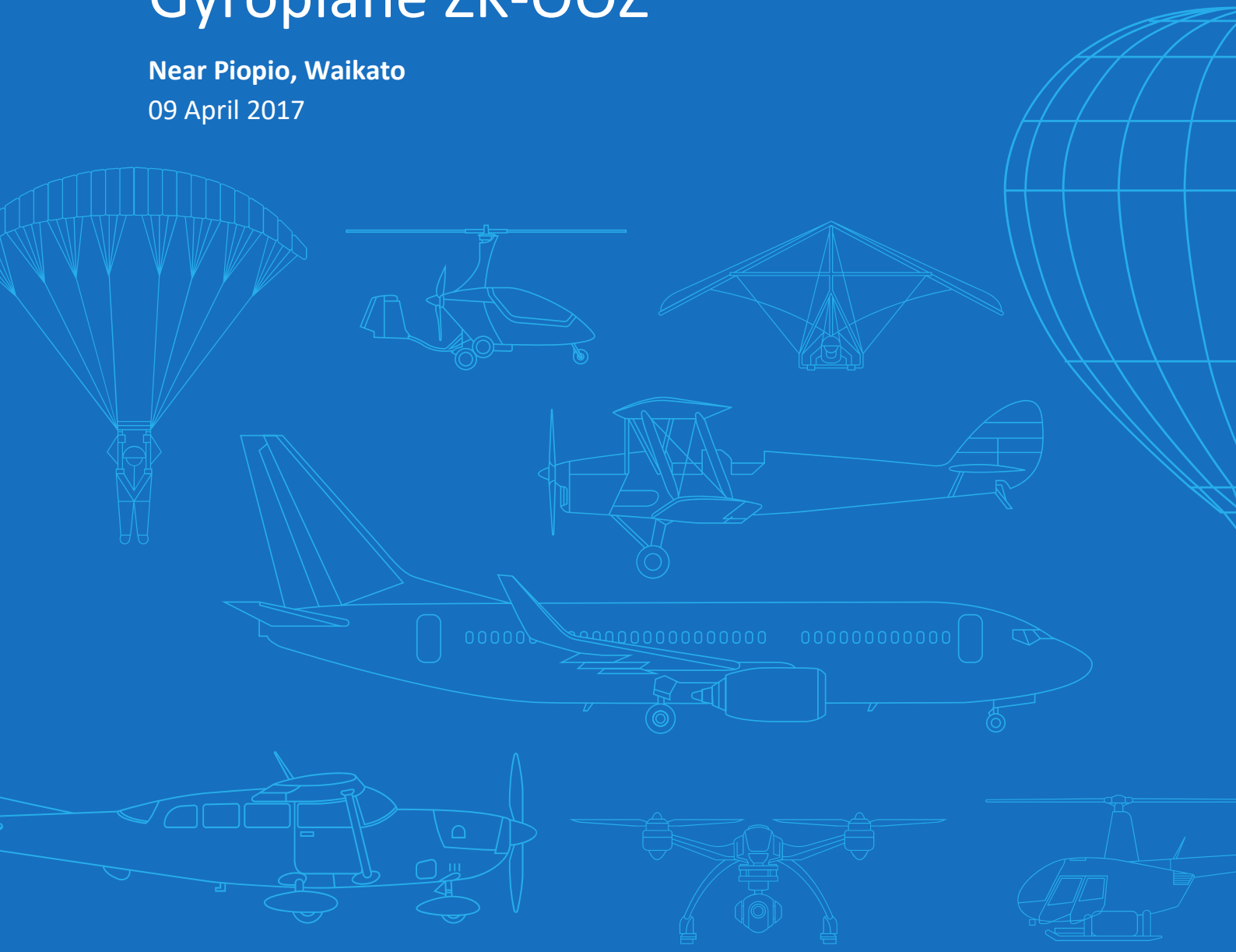
CAA SAFETY INVESTIGATION REPORT

Departure from controlled flight

Montgomerie Bensen B8MR Gyroplane ZK-OOZ

Near Piopio, Waikato

09 April 2017



CAA Final Report 17/1785

18 December 2018

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Executive summary

On 9 April 2017 a microlight pilot flew his privately owned Montgomerie Engineering Limited Bensen B8MR[1], single-seat gyroplane[2], ZK-OOZ for a local flight. It was a sunny day with minimal cloud and light winds. The gyroplane was witnessed conducting a series of low-level manoeuvres before suddenly losing height and impacting terrain. The pilot did not survive.

The accident likely occurred when sufficient relative airflow through the rotor disc was not maintained. This led to a rapid loss of lift, rotor stall, and loss of control.

The investigation identified the following key factors contributed to the accident:

- The inexperienced pilot was conducting flying manoeuvres outside of his capability, and well below the prescribed minimum heights.
- A handling error by the pilot most likely led to a rotor stall and loss of lift. The nature or cause of the error could not be conclusively established.
- Depression and/or medication may have adversely affected the pilot's fitness to fly.
- The Bensen B8MR gyroplane is more difficult to fly than modern gyroplane designs, especially for inexperienced pilots.
- The pilot had limited interaction with the aviation community.

Safety messages

Pilots must fly within the limits of their ability and that of their aircraft

Regardless of the aircraft type flown, it is important that all pilots understand and fly within both the aircraft's limitations, and their own ability. There have been numerous accidents in which pilots failed to understand this, leading to serious injuries or loss of life. Pilots must obtain information about their aircraft's limitations from credible sources in order to learn how to stay safe.

All pilots need to set personal limits. Newly qualified pilots are disadvantaged as they have little experience to draw on to measure where they are operating compared with where the limit of safe operation is. As such, newly qualified pilots need to adopt a conservative approach to all aspects of their operation, setting personal limits above the minimum set out in Civil Aviation Rules.

Pilots must maintain currency and competency to fly safely

It is important that a pilot flies regularly to maintain proficiency on all aircraft that they fly. If they haven't flown recently, it's sensible to familiarise themselves by starting with circuits first, and ideally, do a proficiency check with an instructor.

[1] In this report referred to as Bensen B8MR.

[2] The terms gyroplane, gyrocopter, and autogyro are all used to describe this aircraft type.

Pilots must comply with the Civil Aviation Rules for minimum heights

The minimum heights provide a safety margin and give pilots:

- more time to recover from an unexpected event and/or locate a safe landing area
- less chance of collision with an unmanned aircraft (drone)
- less chance of collision with obstacles or wires
- less chance of injuring people on the ground.

Medical conditions can affect pilots' fitness to fly - pilots should get advice

Many medical conditions and medications can affect any pilot's ability to fly safely.

Regardless of which aviation medical certificate is held, pilots should inform their doctor and pharmacist that they are a pilot. These health care professionals can provide information about medical conditions and medications to help pilots consider their ongoing fitness to fly. More guidance can be obtained from an Aviation Recreation Organisation (ARO) Medical Examiner or the CAA Medical Unit before flying.

Pilots should consider the aviation IMSAFE[3] acronym before flying. Remember the 'M' stands for Medication.

Incident timeline

28 March 2017	The pilot completes an annual flight check in a two-seat Autogyro Europe MT03 eagle (Autogyro MT03) gyroplane for 30 minutes. The instructor comments on the check form "excelant [sic] handling with little flight time''.
29 March 2017	The pilot reports "feeling blue" and visits his local general practitioner (GP). The GP diagnoses mild depression and prescribes Sertraline 50 mg[4].
Next 11 days	No flights flown. The pilot tells his family that the medication "seems to be helping".
09 April 2017	It is a clear, sunny day with light winds, so the pilot decides to go flying in his gyroplane, ZK-OOZ (refer to Figure 3).
Approx. 1315[5]	At Te Kuiti Aerodrome, the pilot completes preflight checks of ZK-OOZ. He is accompanied by his parents. The pilot decides to fly to his employer's home to show them the gyroplane, despite his parents' advice to ''just fly a few circuits".
Approx. 1415	The pilot's parents observe the pilot taxi and take off without incident.

[3] Consider IMSAFE aspects – Illness, Medication, Stress, Alcohol/drugs, Fatigue, Eating https://www.caa.govt.nz/Publications/Posters/im_safe_poster_web.pdf

[4] Sertraline hydrochloride belongs to a group of medicines called selective serotonin reuptake inhibitors (SSRIs). It is used to treat depression as well as other medical conditions.

[5] Approximate (Approx.) times are based on witness recall.

	They observe the gyroplane make a “sharp turn” on departure before flying towards Piopio (where the employer lives), approximately 9.5 NM south (refer to Figure 1).
1430	Piopio golf club members observe the gyroplane flying low overhead.
1431	The pilot’s employer and family see the gyroplane flying low over the farmland in front of their house. They watch the pilot make several low-level passes and steep turns at 30-100 feet[6] in front and below where they are standing. The pilot seems “excited” and “waves several times”.
Approx. 1438	The pilot conducts a particularly low and steep turn and is observed to “wobble”, and the employer thinks “it [the wobble] gave him [the pilot] a fright”. The pilot “appears to recover control” and climbs away to the north.
1439	The pilot waves again and then the gyroplane is seen suddenly turning 180 degrees, toppling to the left and falling out of sight from a height of approximately 100 feet. A local farm owner is also watching the gyroplane, and sees it suddenly fall “like it is dropped from a crane”. The golfers do not witness the accident but hear a “thud” and realise “something has gone wrong”. Refer to Figure 2 for approximate location of witnesses.
1441	Emergency services are alerted by several witnesses.
Approx. 1450	The employer and the golfers run to the site to provide assistance. The gyroplane is found lying on its left side with the pilot motionless inside. Emergency services arrive shortly afterwards but are unable to revive the pilot.

[6] All heights are referenced in feet above ground level.

Incident maps

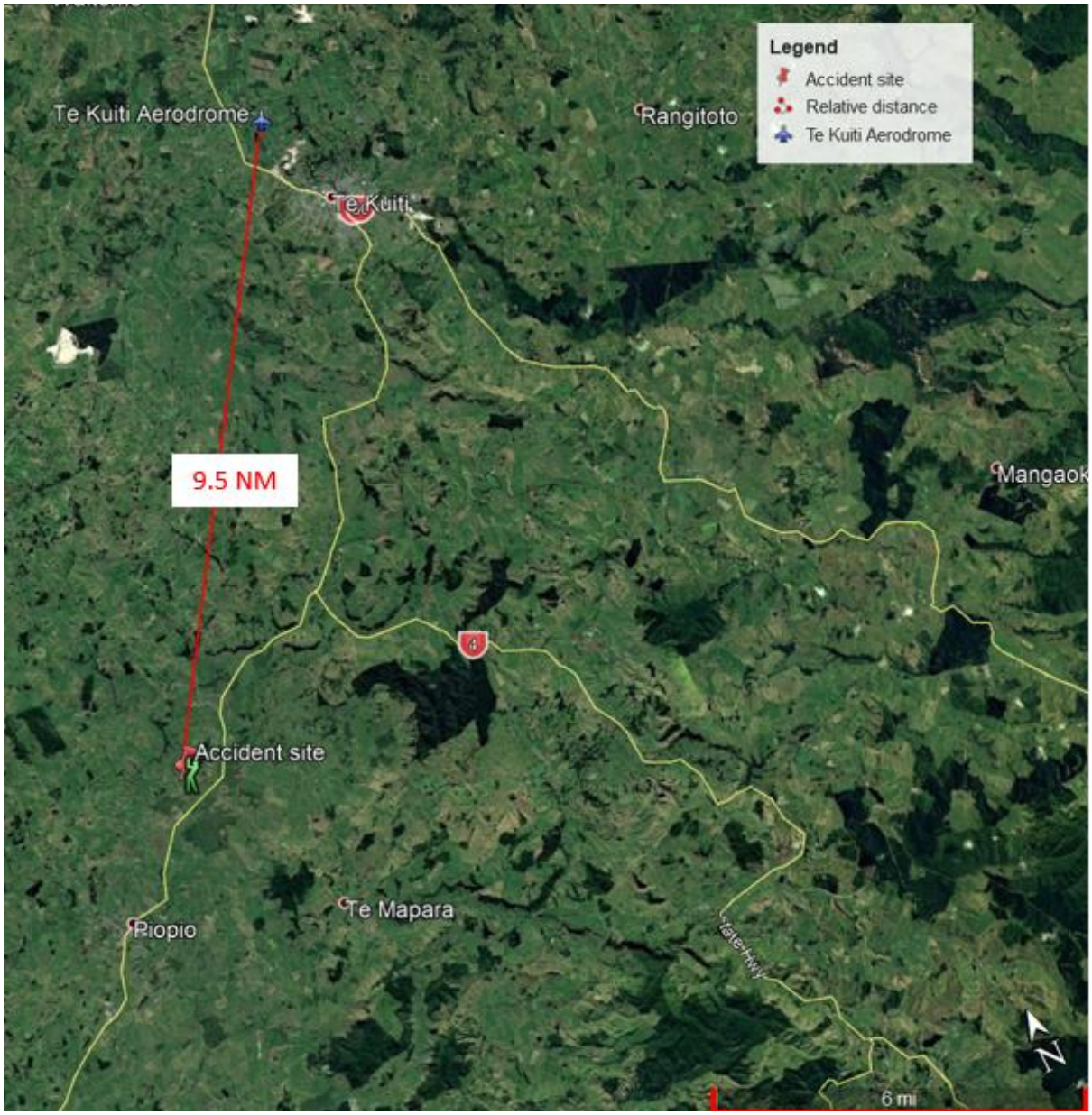

Figure 1: Map of area. The red line shows relative distance from Te Kuiti Aerodrome to the accident site. The actual flight path of ZK-OOZ is not known. (Source: Google Earth ™)

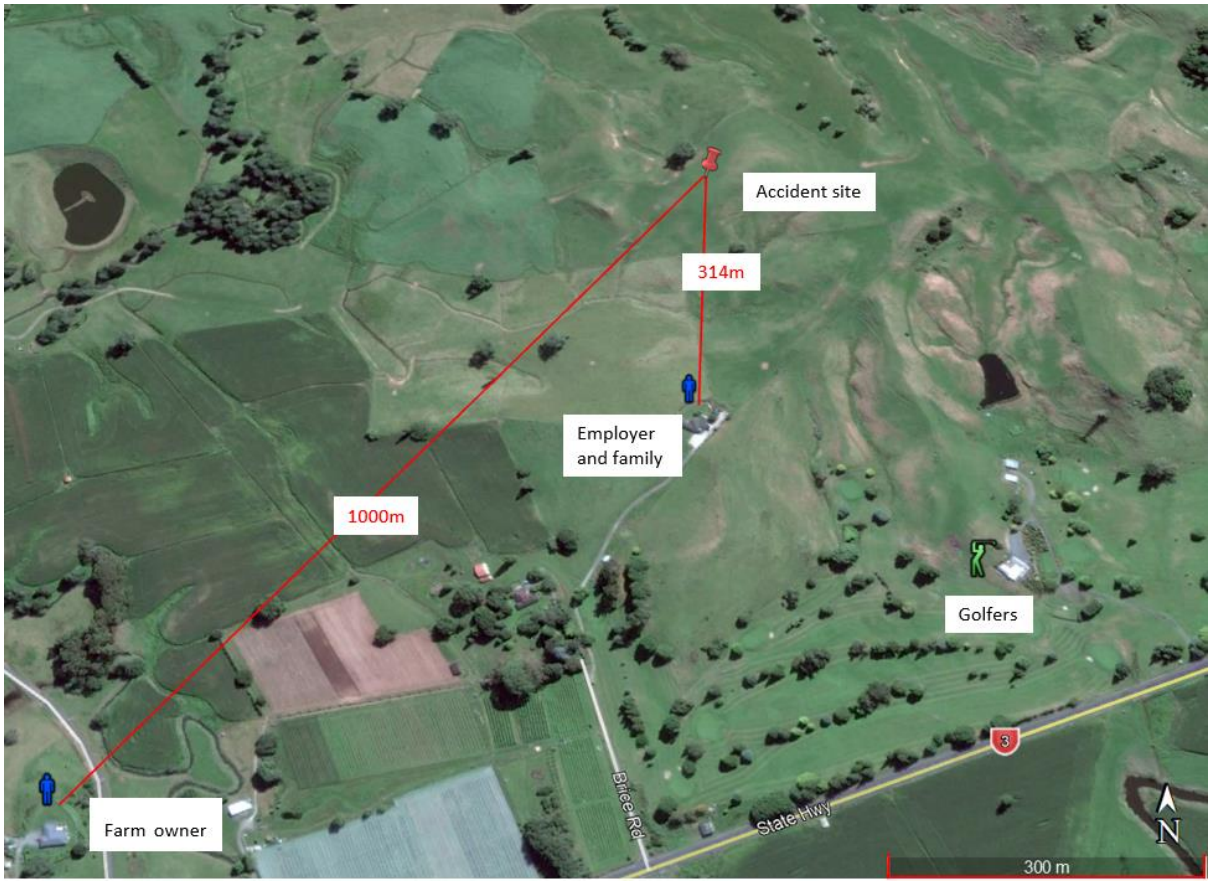

Figure 2: Witness locations relative to the accident site. (Source: Google Earth ™)

Investigation conclusions and findings

Conclusions

The accident likely occurred when the relative airflow through the rotor disc was not maintained. This reduced the angle of attack of the rotor blades, resulting in a loss of rotor speed and a loss of lift.

The loss of the relative airflow most likely occurred as a result of a deliberate or inadvertent control input by the pilot, characteristic of a power push-over (PPO)[7]. The pilot was unable to recover the gyroplane and it fell in a left horizontal attitude from a height of approximately 100 feet. The impact forces were not survivable for the pilot.

The investigation concluded that the pilot of ZK-OOZ had insufficient experience of how to fly his aircraft safely within his capabilities and that of his aircraft. Additionally, his medical condition and medication possibly adversely affected his ability to properly assess the risks of performing hazardous manoeuvres.

[7] Refer to Appendix 1 for further information about power push-over.

Key findings

The investigation covered equipment, human, and environmental factors. The key findings are listed below and are then described in more detail.

- No pre-existing defects were found with the gyroplane.
- The Bensen B8MR gyroplane is more difficult to fly than modern gyroplane designs, especially for inexperienced pilots.
- There was no pilot operating manual for the Bensen B8MR or PPO warning.
- A handling error by the pilot most likely led to a loss of rotor speed and subsequent loss of lift.
- The pilot was conducting flying manoeuvres that he had not been trained for.
- The pilot was flying below the prescribed minimum heights.
- The pilot was inexperienced on the Bensen B8MR.
- Despite a recent successful flight check, the pilot was cautioned by his examiner.
- Depression and/or medication may have adversely affected the pilot.
- The pilot had insufficient guidance to make a decision about his fitness to fly.
- The pilot had limited interaction with the aviation community.
- The weather was suitable for the flight.

Equipment factors

Aircraft information

The Bensen B8MR, registration ZK-OOZ, was powered by a Rotax 582 DCDi two-stroke piston engine, driving a three-bladed, fixed-pitch, Ivoprop pusher propeller. Typical of gyroplanes, lift was provided by the rotation of two main rotor blades driven by the relative flow of air through the rotor disc, in a condition known as autorotation. The power provided by the engine and propeller overcame the total drag of the gyroplane, and provided the forward speed that maintained the airflow through the rotor disc.

Flight control was via a control stick that altered the pitch and roll angle of the rotor disc, and by pedals that operated the rudder. The pitch of the individual rotor blades could not be changed, instead, the entire rotor disc was tilted to turn the gyroplane.

Figure 3: ZK-OOZ-Photo taken shortly after being registration in New Zealand. (Source: Keith Morris 2013)

No pre-existing defects were found with the gyroplane

During the site examination, no mechanical defects which may have contributed to the accident were identified.

Wreckage signatures, together with eyewitness reports, indicated the gyrocopter departed controlled flight following a reduction in rotor rpm. The left side of the fuselage sustained the most impact damage. The rotor blades had minimal damage and were still attached to the rotor mast. The blades were deeply embedded in soft ground, indicating there was minimal, or no rotation on impact. The rudder and right wheel separated from the fuselage during the accident sequence. Integrity of the control systems was established.

A witness reported hearing the gyroplane's engine operating until it impacted the ground. Damage to the propeller and a subsequent engine inspection support the witness's account. Engine failure did not occur.

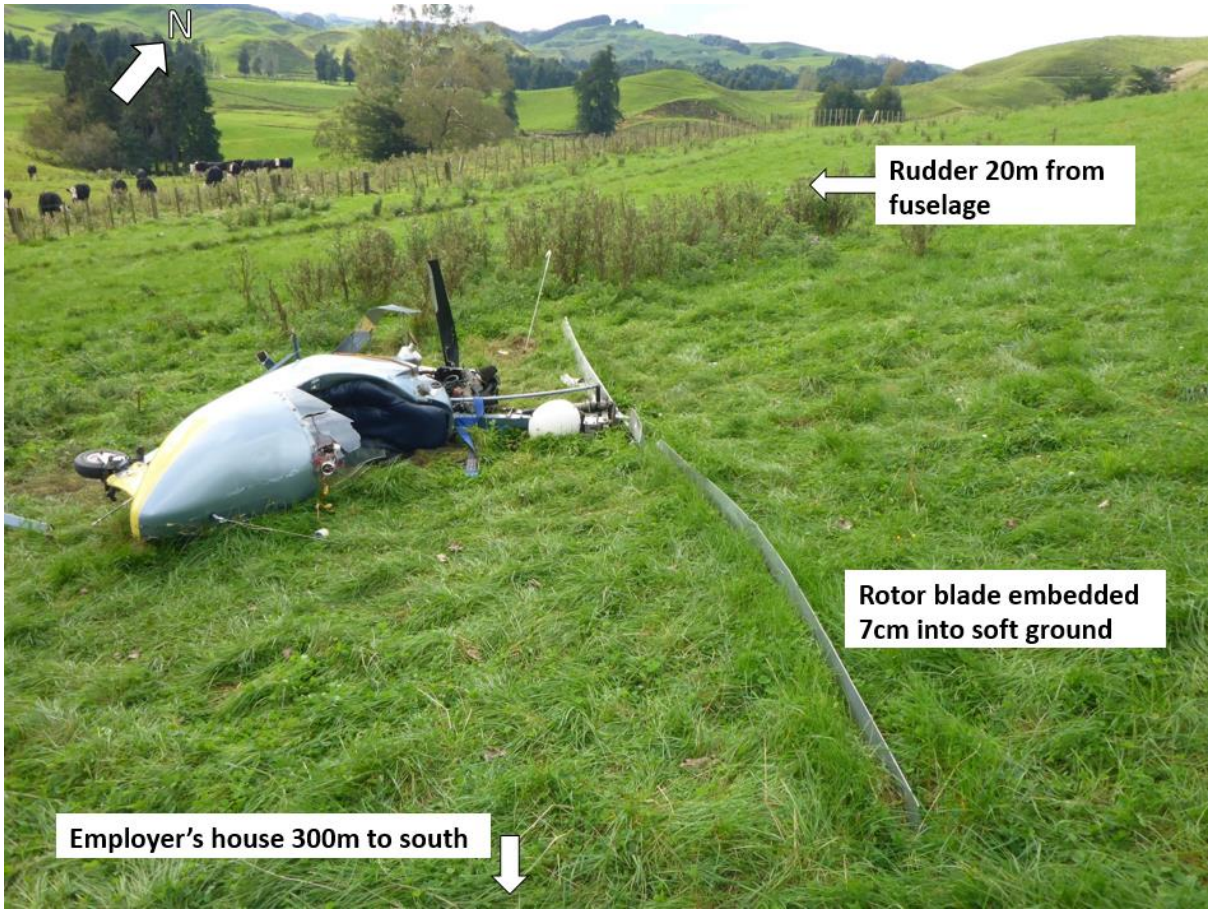

Figure 4: ZK-OOZ-Photograph taken during site examination looking north-west.

The Bensen B8MR gyroplane is more difficult to fly than modern gyroplane designs, especially for inexperienced pilots.

The Bensen B8MR is an older gyroplane design. Its tendency for power push-over combined with its pump-action control stick, makes this a more challenging aircraft for an inexperienced pilot to fly.

Power push-over (PPO)

The Air Accidents Investigation Branch (AAIB) of the United Kingdom (UK) investigated several accidents involving Montgomerie Bensen gyroplanes, and has described the phenomenon of PPO:

> In many autogyros, as in the Bensen [Merlin], the line of engine thrust is higher than the centre of gravity and the centre of fuselage drag. This does not cause any problems so long as the machine is 'hanging' from the rotor blades in a positive 'g' situation. The thrust produced by the rotor blades overpowers the tendency of the engine thrust to push the autogyro nose down. If, however, the rotor thrust is reduced or eliminated, the resulting couple formed by engine thrust and drag destabilises the machine, pitching it nose down. The resulting manoeuvre is called a 'power push-over'. [8]

[8] Air Accident Investigation Branch, UK. Bulletin 1/2001 G-BXDC https://assets.publishing.service.gov.uk/media/5422fbdded915d137100087d/dft_avsafety_pdf_500945.pdf

The AAIB identified a number of situations as having a high risk of a PPO occurring. One situation relevant to this accident is:

> The pilot can 'unload' the rotor by flying a sharp 'pitch over' manoeuvre, pushing the nose down while high power is applied.

It is likely either a deliberate, or inadvertent control input by the pilot in ZK-OOZ led to a PPO.

Pump-action control stick

The Bensen B8MR is also fitted with an older design, pump-action control stick. As the pilot moves the stick forward and aft to provide pitch and roll commands to the rotor system, the stick simultaneously moves up and down.

Pilots have reported the pump action control stick is harder to use than newer designs. Their comments are supported by the AAIB Bulletin 6/2007 G-BIGU accident report, which concluded the combination of this pump-action stick with the Bensen's tendency for PPO, ''…that the aircraft would probably have been difficult to fly, particularly for an inexperienced gyroplane pilot.''

There was no pilot operating manual for the Bensen B8MR or PPO warning

The pilot had no written guidance about his gyroplane. There is no Aircraft Manual or Pilot's Operating Handbook published for the Bensen B8MR. This is not unusual for an older microlight aircraft as it is not a requirement for this category of aircraft.

The aircraft limitations placard (refer to Figure 5) on the right side of the cockpit should have alerted the pilot to the hazards of performing the manoeuvres conducted in ZK-OOZ. There was, however, no specific warning about PPO.

Figure 5: ZK-OOZ/G-BWJN[9] limitations placard.

[9] The gyroplane was built in the United Kingdom and registered as G-BWJN before export to New Zealand in 2010.

Without written guidance it is difficult for pilots to understand their aircraft's limitations and handling characteristics. Therefore, it is important that pilots seek further information and training from credible sources.

Human factors

A handling error by the pilot most likely led to a loss of rotor speed and loss of lift

The pilot had been conducting low-level, sharp-turning manoeuvres. Shortly after this, witnesses reported the gyroplane pitching steeply, nose-down and "tumbling" or "dropping", which is a characteristic seen as a result of a PPO. This was likely due to an abrupt forward control input by the pilot, either as part of a planned manoeuvre or an inadvertent control input.

The pilot was conducting flying manoeuvres that he had not been trained for

The pilot had not been trained to conduct the low-level turning manoeuvres described by witnesses. The golf club members observed the gyroplane flying low overhead "swooping and diving and disappearing over the ridge". The pilot's employer and wife reported observing the pilot conduct a sequence of tight turning manoeuvres performed at low level. When these manoeuvres were described to the pilot's instructor by the safety investigator, he stated he had not taught them and had never observed the pilot performing them.

The pilot previously worked as a ground loader for an agricultural helicopter operator. He had recently watched television programmes and social media depicting gyroplanes conducting low level, tight turns. It is possible the pilot was trying to imitate these manoeuvres, without being aware of the skill level required to conduct them safely.

Low-level turning manoeuvres such as those described above are permitted only for qualified agricultural and approved display pilots, and require a high level of skill, training, and ongoing competency checks to conduct them safely.

The risks of conducting manoeuvres outside a pilot's ability or capability of their aircraft are well known in the aviation community. Numerous fatal accidents[10] have resulted when pilots don't heed the safety message to fly within their ability and the limitations of their aircraft.

The pilot was flying below the prescribed minimum heights

It was estimated the loss of control occurred at approximately 100 feet. The engine throttle was found almost fully closed which may have been an attempt by the pilot to recover from the PPO. Had the gyroplane been higher this would have provided the pilot more time to potentially recover from a handling error or other inflight emergency.

The heights flown in the vicinity of the pilot's employer and family were estimated between 30 and 100 feet. This was well below the 500 feet mandated by Civil Aviation Rule 91.311 *Minimum heights for VFR flights* (2) (i) and (ii), and endangered those on the ground, as well as the pilot.

[10] CAA Fatal Accident reports 11/2157 Autoflight Dominator ZK-RAW, 2011; 10/885 Cessna U206G ZK-SKT, 2010 and Australian Transport Safety Bureau (ATSB) reports AO-2015-074 Pitts Model 12, VH-JDZ, 2015 and AO-2012-059 Cessna 150, VH-UWR, 2012 are examples of such accidents.

The pilot should have been aware of these minimum heights, as this is included in the Recreational Aircraft Association of New Zealand (RAANZ) Aviation Law exam syllabus, which the pilot passed in 2014. The pilot's instructor reported observing the pilot fly at heights considered "too low" and that he stressed the importance of flying higher to the pilot during his flight training.

It is important that pilots comply with the prescribed minimum heights.

The pilot was inexperienced on the Bensen B8MR

It was estimated the pilot's total flight experience was between 45 and 55 hours with approximately 20 to 30 hours on ZK-OOZ. He had flown only a few hours in his gyroplane in the past few years (refer to Appendix 2 Pilot Information).

ZK-OOZ was an older gyroplane design with a sensitive pump-action control stick and a susceptibility to PPO, which made it a more challenging aircraft to fly for this inexperienced pilot.

As part of the gyroplane training syllabus the pilot received instruction about PPO and the correct recovery technique for this. The instructor reported discussing both the capabilities and limitations of ZK-OOZ and the importance of exercising caution. The pilot was advised to "be very restrictive in his flying–to fly in a modest manner".

It is not known the extent of the pilot's knowledge of the Bensen B8MR gyroplane type other than that covered by his flight training. Though the UK AAIB had published several Bensen B8MR gyroplane accident reports[11] which discussed the risk of PPO, the pilot's family didn't think the pilot had read them.

There was no written guidance provided by the manufacturer, so it was up to the pilot to conduct further research into his gyroplane. This is not unique to this aircraft and many other microlight owners would be in a similar position.

The pilot had flown infrequently in the past two years other than the dual flight checks in the Autogyro MT03. The pilot's instructor, family, and former employer (helicopter operator) had all recommended that the pilot sell the gyroplane if he was not going to fly it regularly.

Lack of pilot currency is a well-known contributing factor in many accidents and the CAA urges pilots to fly regularly to maintain proficiency on all aircraft that they fly.

Despite a recent successful flight check, the pilot was cautioned by his examiner

The pilot completed a recent (28 March 2017) flight check to a good standard. The examiner[12] made the comment on the check report, "excelant [sic] handling with little flight time". Likewise, the pilot's 2015 check report with the same examiner recorded "Good flying skill considering lack of flying. MUST FLY MORE".

The examiner reported being amazed at how well the pilot performed on each check given he had so little (recorded) flight time. He stated that the pilot demonstrated an aptitude for flying at the outset

[11] Air Accident Investigation Branch, UK. Bulletins 6/91 G-BRZM; 2/94 G-BOYK; 1/2001 G-BXDC: 12/2002 G-INCH; 6/2007 G-BIGU; 8/2010 BIPY; https://www.gov.uk/aaib-reports

[12] The examiner had also conducted most of the pilot's initial gyroplane training and his single-seat conversion on ZK-OOZ.

and passed both the theory and practical flying requirements for the Intermediate Certificate to a good standard "(the pilot) flew well. Full stop! A very talented aviator!".

Despite this performance, the examiner cautioned the pilot to fly conservatively and advised him to either fly more frequently to maintain proficiency or sell the gyroplane.

Depression and/or medication may have adversely affected the pilot

The low-flying manoeuvres performed that day demonstrated an element of risk-taking that seemed out of character for the pilot. The pilot's current and previous employers spoke highly of his diligence and responsible attitude at work. His instructor reported that he had never observed the pilot flying in a hazardous manner.

His family said that the pilot had made a decision to sell his high performance motorbike, in part due to concerns about personal safety. This demonstrated his ability to consider risk and make decisions accordingly.

The pilot held a RAANZ Medical Declaration and Certificate[13] issued by the pilot's local GP on the 29 April 2013 (due for renewal on 29 April 2017). The same GP saw the pilot 11 days before the accident and diagnosed mild depression. The pilot was prescribed an antidepressant, Sertraline and referred for counselling.

The Medsafe data sheet for Sertraline lists agitation, impulsivity, mania and hypomania[14] as possible side effects. The Consumer Medicine Information (patient leaflet) states; "Be careful driving or operating machinery until you know how (brand name) SERTRALINE affects you".

The pilot's parent said there was no discussion about the pilot's flying hobby during the GP consultation. The GP and dispensing pharmacist did not provide the pilot with information about how the pilot's depression or Sertraline could possibly affect the pilot's ability to safely perform potentially hazardous tasks such as driving a car or operating machinery like his gyroplane.

The RAANZ Medical Declaration and Certificate states:

> Any minor injury, medically prescribed drugs, dental anaesthesia, and illness not referred to on this medical declaration and blood donation probably makes the pilot temporarily unfit to fly. The pilot should seek medical advice before resuming flying.

As the pilot had consulted the same GP who issued his Medical Declaration and Certificate, it is possible the pilot considered that he had 'sought medical advice' before flying.

The family reported that the pilot started taking his medication immediately after it was prescribed and that ''it appeared to be helping [the pilot]". On the day of the accident, the pilot was reported by family as being "happy" and ''somewhat excited". His employer also commented that the pilot appeared "excited" when flying in front of them. A CAA Senior Medical Officer said "this behaviour

[13] Pilots undergo a medical examination conducted by a GP. It is renewed every four years. This examination is less restrictive than a CAA Class 2 Medical Certificate issued by a CAA approved Medical Examiner which is renewed two yearly.

[14] Hypomania is a mild form of mania, marked by elation and hyperactivity.

may be a natural response to an enjoyable activity or it could be euphoria induced by the medication".

As the risk-taking behaviour seemed out of character for the pilot, it is possible his judgement and/or attitude to risk-taking when flying the gyroplane that day was adversely affected either by the depressive disorder or the medication to treat it.

Environmental factors

The pilot had insufficient guidance to make a decision about his fitness to fly

A member of the pilot's family stated the pilot was not provided with information about the possible side effects of the medication or adverse effects of the pilot's condition. Therefore neither they nor the pilot was able to make an informed assessment on the pilot's fitness to fly.

In a police statement the GP stated,"the medication has a general warning about driving and operating heavy machinery, however it is not prohibited". The GP said they "did not expect that it [the medication] would inhibit [the pilot's] performance".

CAA Medical Information Sheet: Depression (MIS016) provides guidance for pilots with depression, and outlines the adverse effects it may have on a pilot's ability to fly safely. Refer to Appendix 5 for the link to the MIS016. It is not known if the GP was aware of the advice provided in the MIS016.

The CAA Principal Medical Officer stated,"had the pilot held a CAA-issued medical and the CAA had known about the newly diagnosed condition and prescription, that the pilot would most likely have had his medical suspended until stabilised on the medication and any adverse effects had been fully evaluated".

Without sufficient information, pilots cannot make an informed decision about their fitness to fly.

The pilot had limited interaction with the aviation community

Microlight activities in New Zealand are administered by an Aviation Recreation Organisation (ARO) such as RAANZ, under delegation from the Director of Civil Aviation.

RAANZ is a club-based organisation where most of its members have continual support from other experienced pilots and instructors. ZK-OOZ's pilot/owner, however, lived a considerable distance from his local gyroplane school and a RAANZ club, and there were no local gyroplane pilots to mentor him. This meant the pilot was operating his gyroplane without the benefit of immediate oversight or guidance. This is not an unusual situation for many remotely based pilot/owners, regardless of the aircraft they fly.

Without the benefit of a nearby mentor, or undertaking advanced flight training, the pilot was at risk of forgetting what he had learned and not expanding his knowledge or experience.

Ultimately it is every pilot's responsibility to gain and maintain the knowledge and skills required to fly safely.

The weather was suitable for the flight

Witnesses to the accident and/or attended the scene described the weather conditions as sunny, with light winds and very few clouds. The weather conditions were suitable for the flight.

Safety actions

Actions already taken/in progress

CAA Microlight Seminar November 2017

In November 2017 a microlight seminar was coordinated by CAA, aimed at instructors, senior persons from AROs, microlight associations and clubs. A wide range of topics was discussed, including issues around pilot knowledge, maintenance of competency, aircraft maintenance, and mentorship.

CAA safety publications

Shortly after this accident the CAA published an article in *Vector*[15] entitled "*So You Want to Fly a Gyro"*[16]. This article covered many aspects of flying and owning a gyroplane, including a caution about emulating flying seen online.

The CAA will continue to publish *Vector* articles highlighting safety issues, with the aim of reaching as many pilots as possible. The AROs supply direct links to these CAA safety publications on their websites.

Aviation Recreation Organisations (ARO) and NZ Autogyro Association (NZAGA)

Several AROs were approached to discuss how to best address the issues raised during this safety investigation. These organisations endorse every effort to improve flying skills, and encourage all recreational pilots to undertake refresher courses.

The AROs' comments and initiatives are summarised below:

- "RAANZ is a club-based organisation where most of its members have continual support from other experienced pilots and instructors, and where there is a strong safety culture and peer pressure to comply with aviation rules and fly safely." CEO, RAANZ.
- RAANZ communicates safety messages via the monthly E-Zine magazine. Issue 133 (refer to Appendix 4) specifically stressed the importance of pilots maintaining currency and flying within their abilities.
- RAANZ has held NZ-wide safety seminars where all aspects of flight safety, pilot skills and currency, rule changes, and aircraft maintenance are discussed in an open forum. The Sport Aviation Corp will hold similar pilot safety field days for all members but aimed

[15] *Vector* is a free publication distributed to all New Zealand certificate and document holders. It is also available on the CAA website https://www.caa.govt.nz/safety-info/vector/

[16] https://www.caa.govt.nz/assets/legacy/Publications/Vector/Vector-2017-5.pdf

particularly for private owners who have less access to mentorship. Other AROs will be invited to contribute and participate.

- RAANZ has recently finalised an Instructional Techniques Course to establish a high level of flight skills and adherence to flight safety amongst RAANZ instructors, which will set a high standard for all their pilots.

"In the end it is the pilot's responsibility to ensure that knowledge, experience, skills, and the equipment are all up to standard, but is also the responsibility of everyone around to encourage it." President, NZAGA.

Gyroplane training organisation

The organisation where the pilot learned to fly the gyroplane was sold, subsequent to the pilot gaining his Intermediate Certificate. The new owners have expanded the operation to include helicopter, fixed-wing and gyroplane flight training. They intend to incorporate much of the private licence flight training syllabus into the microlight and gyroplane flight training programmes. They intend to work closely with the NZAGA and AROs to assist all gyroplane pilots to fly safely.

Review of aircraft register for Montgomerie Bensen gyroplanes

Only one Montgomerie Bensen gyroplane type remains on the aircraft register. The owner is aware of the CAA UK Mandatory Permit Directive (MPD) (refer to Appendix 1) and AAIB accident reports, and has close mentorship from the NZAGA and the gyroplane training organisation.

A recommendation for the CAA to embody the CAA UK MPD was considered, but direct contact with the owner of the other Montgomerie Bensen gyroplane was deemed a more effective way to communicate the safety messages.

Accident data summary

Aircraft make and model, registration, serial number, and total hours.	Montgomerie Engineering Limited, Bensen B8MR, G-BWJN (UK)/ZK-OOZ (NZ), PFA G/01-1262. Approximately 400 hours total time (358.35 recorded).
Year/place of manufacture:	1996, United Kingdom
Engine make and model, type of engine, total hours:	1 Rotax 582 DCDi two-stroke piston engine. Approximately 400 hours total time (358.35 recorded).
Year/place of manufacture:	1995, United Kingdom
Imported to NZ:	October 2010, registered December 2012
Last inspection:	10 January 2015, nil defects.
Accident date and time:	09 April 2017, 1439 NZDT[17]
Location:	Near Piopio
	Latitude: S 38° 26' 25.0”
	Longitude: E 175° 02' 52.5”
Altitude:	554 feet above mean sea level
Type of flight:	Private VFR local
Persons on board:	Crew: 1
Injuries:	Crew: Fatal
Nature of damage:	Destroyed
Pilot’s licence:	Microlight Intermediate Flight Certificate (G)
Pilot’s age:	25 years
Pilot’s total flying experience:	45 to 55 hours total (approx.)
	25 to 35 hours on type (approx.)
Information sources:	Civil Aviation Authority field investigation.
Investigator in Charge	Ms L Child

[17] NZDT: New Zealand Daylight Time which is Greenwich Mean Time +13 hours

Appendix 1: Montgomerie Bensen gyroplanes' susceptibility to power push-over

In gyroplane flight, lift is provided by the rotation of the rotor blades. Rotation is maintained by the upward flow of air through the rotor disc (autorotation). The airflow is provided by the gyroplane's forward motion produced either by the thrust from the engine, or if the engines fails, by the gyroplane's descent under gravity. In either case, the upward flow of air through the rotor disc is essential to maintain rotor RPM and sustain autorotation.

If the pilot pushes forward too rapidly on the control stick ('bunting forward') the rotor disc's angle of attack will reduce and the ensuing loss of lift will unload the rotor (ie, less than 1g). Failing to maintain airflow through the main rotor causes the rotor to slow down and, if it slows down excessively, the retreating blade can aerodynamically stall with subsequent blade flap.

The Bensen B8MR gyroplane has an engine thrust line higher than the centre of gravity[18] so when power is applied, it has a tendency to pitch nose-down which further unloads the rotor (refer to Figure 6). In normal flight this tendency is countered by the lift or rotor thrust from the main rotor blades. However, if this balance is lost the nose will pitch down, known as a 'power push-over' (PPO). This rapidly becomes irreversible with a subsequent loss of lift and the gyroplane will 'tumble', unless immediate corrections are made by the pilot. This phenomenon occurs rapidly and without warning.

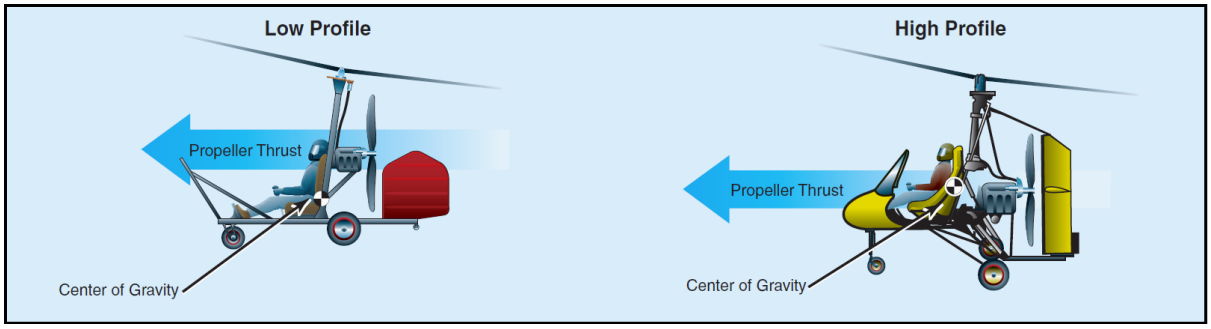

Figure 6. A low profile gyroplane has the propeller thrust line above the centre of gravity (CG). The high profile gyroplane has the thrust line at or below the CG and is more stable. (Source: FAA Rotorcraft handbook p16-6)

A number of situations have been identified as having a high risk of a PPO occurring.

- Pilot induced oscillations (PIO), can occur when control movement is out of phase with the gyroplane's natural movement. Large pitch oscillations can cause the rotor disc to tilt forward, suddenly reducing the load on the blades. In this condition engine thrust can pitch the gyroplane nose down. This can often happen in turbulence.
- Flight with excess airspeed.
- The pilot can 'unload' the rotor by flying a sharp 'pitch-over' manoeuvre, pushing the nose down while high power is applied, such as after a steep climb.
- A strong gust of wind changes the angle of airflow and 'unloads' the rotor blades.

[18] The centre of gravity is the point about which the aircraft's weight is said to act.

Pilots can avoid PPO by:

- reducing engine power in the event of a PIO developing
- reducing speed, or
- changing power settings before changing pitch.

In the event of a PPO the correct recovery technique is to reduce thrust and try to reload the rotor. As a loss of lift can happen very quickly, the emphasis is on avoiding PPO.

Mandatory Permit Directive, MPD: 2005-008 - Gyroplanes

Following a series of gyroplane accidents between 1989 and 1991, the Civil Aviation Authority United Kingdom (CAA UK) engaged the University of Glasgow to undertake several studies into gyroplane stability. These studies found:

> The single most significant factor in determining the longitudinal stability of gyroplanes is the vertical location of the centre of gravity relative to the propeller thrust line. [19]

On 24 August 2005 the CAA UK issued MPD: 2005-008 - Gyroplanes (refer to Figure 7) which states:

> CAA flight testing of some Bensen derivative gyroplanes has found that poor handling characteristics exist if such machines have a thrust line / CG offset that exceeds +/- 2 inches. The CAA considers that inexperienced gyroplane pilots are at risk due to these handling characteristics and that this combination constitutes an unsafe condition.

To reduce this risk, this MPD introduced a maximum air speed (VNE)[20], wind speed and gust limitations, and requires a horizon reference on all single-seat machines. It also stipulates that pilots must have a minimum of 50 hours solo gyroplane flight time following the issue of their PPL (G) before flying these gyroplanes.

These restrictions are not mandatory in NZ due to the different certification requirements for these aircraft. Only one Montgomerie Bensen gyroplane type remains on the aircraft register. A recommendation for the CAA to embody the CAA UK MPD was considered but direct contact with the owner of this other Montgomerie Bensen was deemed more effective.

[19] Safety Regulation Group, August 2010. *CAA Paper 2009/0:2 The Aerodynamics of Gyroplanes* p194. Civil Aviation Authority, United Kingdom.

[20] The limitations placard for G-BWJN/ZK-OOZ (refer to Figure 5 on page 12) had not been changed to the lower VNE speed limitation of 70mph as required by MPD 2005-008 - Gyroplanes before export to New Zealand. As the gyroplane was not flying near either of these VNE limits at the time of the accident, this was not considered a contributory factor to the accident.

United Kingdom
Civil Aviation Authority

MPD No: 2005-008

Issue Date: 24 August 2005

MANDATORY PERMIT DIRECTIVE

In accordance with Article 9A(5)(b) of the Air Navigation Order 2000 as amended, the following action required by this Mandatory Permit Directive (MPD) is mandatory for applicable aircraft registered in the United Kingdom operating on a UK CAA Permit to Fly.

MPD: 2005-008 - GYROPLANES

Subject: CG/Thrust Line offset

Applicability: All single seat gyroplanes.

Reason: CAA flight testing of some Bensen derivative gyroplanes has found that poor handling characteristics exist if such machines have a thrustline /CG offset that exceeds ± 2 inches. The CAA considers that inexperienced gyroplane pilots are at risk due to these handling characteristics and that this combination constitutes an unsafe condition.

In order to reduce this risk, this MPD introduces a V_{NE}, wind speed and gust limitations and a requirement for a horizon reference on all single seat machines. In addition, a minimum pilot experience limitation is introduced for machines with a cockpit/nacelle and a minimum power-on airspeed is introduced for open-frame machines.

Pilot experience, V_{NE} and wind/gust restrictions may be removed if acceptable evidence is presented to the CAA to show that the thrust line/CG offset is within ± 2 inches.

Compliance with those aspects highlighted as "must be approved by the CAA/PFA" will normally be achieved by a submission to the PFA. Any alternative arrangements are to be agreed with the CAA on a case by case basis.

Compliance: This MPD applies the following limitations on all single seat gyroplanes and must be retained with the Permit to Fly:

1. **Single seat gyroplanes incorporating cockpit/nacelle;**

1.1 Minimum experience of pilots flying such machines must be 50 hours logged solo gyroplane flight time following the issue of his/her PPL (G).

1.2 Flight when surface winds, including gusts, exceed 15 knots (17 miles per hour) is prohibited.

1.3 Flight when surface wind gust spreads exceed 10 knots (12 miles per hour) is prohibited.

1.4 Continued flight in moderate, severe or extreme turbulence is prohibited. Adjust forward airspeed to 55 knots (63 miles per hour) IAS or below upon inadvertently encountering moderate, severe or extreme turbulence.

continued overleaf

Enquiries regarding this MPD should be referred to Certification and Approvals Department, Civil Aviation Authority, Safety Regulation Group, Aviation House, Gatwick Airport South, West Sussex, RH6 0YR. Phone: 01293 573306 Fax: 01293 573976 E-mail: alistair.maxwell@srg.caa.co.uk

1.5 V_{NE} is reduced to 70 MPH (61 Knots) IAS or equivalent units appropriate to the instruments installed.

1.6 Before next Flight, install a placard, clearly visible to the pilot, identifying the V_{NE} restriction of 70 MPH (61 Knots) IAS or equivalent units appropriate to the instruments installed.

1.7 Prior to any flight more than three months after the effective date of this MPD a horizon reference acceptable to the CAA/PFA must be fitted.

1.8 The requirement for the limitations introduced under items 1.1, 1.2, 1.3, 1.4 and 1.5 and the requirement for the placard to be installed under 1.6 may be removed if evidence is provided (using a method acceptable to the CAA), that the thrust line/CG offset is within $\pm$ 2 inches.

1.9 Any modification required to bring the thrust line/CG offset within $\pm$ 2 inches must be approved by CAA/PFA and may involve flight testing.

1.10 Weight balance and Thrustline/CG offset must be confirmed by a method acceptable to the CAA after any modification referred to in 1.9 has been incorporated and the results reported to the CAA and recorded in the Gyroplane Maintenance record.

1.11 Thrust line/CG determination must include fuel tank conditions from full to empty and a range of pilot weights. The pilot weights used should be declared as placarded limitations clearly visible to the pilot.

2. Single seat open frame gyroplanes

2.1 The V_{NE} for all open frame machines is reduced to 70 MPH (61 Knots) IAS with immediate effect.

2.2 Before next flight install a placard, clearly visible to the pilot identifying the V_{NE} restriction of 70 MPH (61 Knots) IAS or equivalent units appropriate to the instruments installed.

2.3 Flight when surface winds, including gusts, exceed 15 knots (17 MPH) is prohibited.

2.4 Flight when surface wind gust spreads exceed 10 knots (12 miles per hour) is prohibited.

2.5 Continued flight in moderate, severe or extreme turbulence is prohibited. Adjust forward airspeed to 55 knots (63 MPH) or below upon inadvertently encountering moderate, severe or extreme turbulence.

2.6 The gyroplane minimum airspeed, other than in the landing flare, is 30mph (26 knots). This limitation must be stated on a placard clearly visible to the pilot.

2.7 Prior to any flight more than three months after the effective date of this MPD, a horizon reference acceptable to the CAA/PFA must be fitted.

2.8 The airspeed restrictions referred to in paragraph 2.1, 2.2, 2.3, 2.4 and 2.5 may be removed if acceptable evidence is presented to the CAA to show that the thrust line/CG offset is within $\pm$ 2 inches. Any modifications necessary to bring this about must be approved by the CAA/PFA and may involve flight testing.

2.9 Thrust line/CG determination must include fuel tank conditions from full to empty and a range of pilot weights. The pilot weights used must be declared as placarded limitations clearly visible to the pilot.

Note: Moderate turbulence is turbulence that causes (a) changes in altitude or attitude, (b) variations of indicated airspeed, and (c) aircraft occupants to feel definite strains against the seatbelts or any tendency to a reduction in positive G-forces.

A PFA gyroplane inspector or other person acceptable to the CAA for the purpose must inspect the machine and record compliance with this MPD in the aircraft log book before further flight.

This MPD becomes effective on 24 August 2005.

Figure 7. Mandatory Permit Directive MPD-2005-008 - Gyroplanes, Civil Aviation Authority United Kingdom.

Appendix 2: Pilot information

The pilot held a Recreational Aircraft Association of New Zealand (RAANZ) Intermediate Flight Certificate (refer to Appendix 3) issued on 4 May 2014, and a valid RAANZ Medical Declaration and Certificate, issued on 29 April 2013 with no restrictions.

Timeline

Jan 2012	The pilot starts flight training on a Cessna 172, light aeroplane at the local aero club. He completes 3.8 hours dual instruction.
Dec 2012	The pilot begins flight training in a two seat Autogyro Europe MT03 eagle with a Tauranga gyroplane training organisation[21]. He completes 20.8 hours of flight training.
Nov 2013	The pilot purchases ZK-OOZ from the training organisation and commences single-seat conversion training.
May 2014	The pilot completes the requirements for the issue of a RAANZ Intermediate Flight Certificate which permits solo flights within 10 nautical miles of base. He has a total of 33 hours logged.
14 Nov 2015	Annual flight test in Autogyro MT03 completed to good standard. Two hours flight time had been logged since May 2014.
Nov 2015 - Mar 2017	No flights logged other than the flight tests.
28 Mar 2017	Flight test in Autogyro MT03 completed to good standard.

Pilot flight hours

The pilot had logged a total of 35 hours but his family recalled he had flown ZK-OOZ more than what was recorded in his Pilot's Logbook. It was estimated that the pilot's total flight experience was between 45 and 55 hours. The pilot's flight instructor/examiner did not know if the pilot had flown more frequently but simply hadn't recorded it. He told the pilot "to maintain a better logbook".

For a full breakdown of flight experience refer to Table 1: Pilot flight hours.

[21] The organisation has an aircraft sales division as well as flight training.

Description of flight hours		Flight hours (decimal) [22]
Total hours	logged estimated	35.3 45 to 55
Last 7 days		0
Last 30 days		0.5 dual
Last 90 days		0.5 dual
Bensen B8MR	logged estimated	8.9 solo 25 to 35 solo
Autogyro MT03		22.6 all dual
C-172		3.8 all dual

Table 1: Pilot flight hours

[22] Based on logbook entries. It is likely that there were several flights completed but not entered.

Appendix 3: RAANZ Certificate Structure

Recreational Aircraft Assn. of New Zealand (Inc.)

RAANZ Certificate Structure: Requirements, Privileges and Limitations

RAANZ Inc
Freepost 102829
PO Box 15-016
Dinsdale 3243
Hamilton

07 825 2800
office@raanz.org.nz
www.raanz.org.nz

current June 2007

Mandatory requirement for certificate/endorsement
Optional requirement or optional privilege
Privilege NOT available
Limitation on certificate/privilege

Certificate level Endorsements	Min age	Medical declaration	Fit & Proper declaration	Min flight experience	Exam	FRTO	Cross country	Flight test	Pax rating	Flight limitations	Certificate validity
Novice	16	Required	Required on entry	None				None	No	All flights instructor approval	1 year
First solo	Logbook endorsement by Senior Instructor of completion of basic training syllabus										
Intermediate	16	Required	Required on entry	25 hrs 15 hrs for PPC	Required	If radio used or within 10NM controlled airspace		Required	No	10NM of base	1 year
Advanced Local	16	Required	Required on entry	40 hrs	Required	If radio used or within 10NM controlled airspace	Local cross-country	Required	Available	50NM of base	2 years
Advanced National	16	Required	Required on entry	45 hrs	Required	Required	National cross-country	Required	Available	None	2 years
Passenger Rating				45 hrs with 35 hrs PIC 30 hrs for PPC						3 t/o and landings in previous 90 days	
Local cross-country	Min of 4 exercises, 5 hrs total, 2 hrs solo x/c, including 1 hr/3 leg flight, high level, low level, mountain, weather diversion										
National cross-country	Min of 4 exercises, 10 hrs total, 4 hrs solo x/c, including 3hr/3 leg flight, high level, low level, mountain, weather diversion, controlled airspace										
Flight Instructor	Advanced National certificate, 150 hours (10 microlight, 10 x/c) Club recommendation, sponsor ATO Instruction/flight exam and test, Instruction Skills seminar (within 2 years),								No first solo authorisation No Advanced flight testing No Pax rating testing		1 year
Senior Flight Instructor	Flight Instructor certificate, 200 hrs TT, 50 hours flight instructing time 2+ students from ab initio to first solo, Instruction skills seminar Sponsor ATO discretion										1 year

Appendix 4: RAANZ Recreational Pilot e-zine

Issue 133 August 2018

Potential Disasters (page 5)

Bill Penman/RAANZ OPS.

There is nothing like the enjoyment and excitement of obtaining a pilots certificate/ licence or even being lucky enough to own your first aircraft. There is a sense of exhilaration to have the freedom (almost) of the skies, to be like a bird and demonstrate to all your friends and family your new found skills, or not!

Unfortunately statistics show that throughout all facets of aviation that there are those that will push the boundaries with disastrous results.

There is an old adage that obtaining a licence is a licence to learn. There have been many articles and books written about experiences and 'how I learned from that', and the culmination of reaching a certain number of hours where the pilot thinks they are more experienced than they really are.

Social media is an avenue that unfortunately allows flying activities to be filmed that are pretty unsavoury and have the potential to go horribly wrong. These do have an effect of inciting some to 'have a go' as well.

Some of the ensuing factors that contribute to an eventual disaster are:

• Lack of flying experience or being new to the aircraft type

• Lack of recent flying- skills were rusty

• Conducting hazardous manoeuvres, often at low level

• Flying too low to recover from an emergency such as a stall

• Running out of fuel (exhaustion) or not managing the fuel supply (starvation)

• Flying in weather conditions not suitable for the flight

• Being a "Loner Ranger and the master of your own destiny" (to quote Ross St George a past CAA safety adviser)

RAANZ is a club based organisation where most of its members have continual support from other experienced pilots and instructors, where there is a strong safety culture and peer pressure to comply with aviation rules and fly safely. For those that are more isolated it may help to be given some sound cautionary advice at BFR time by their instructor. Have a good think about what you are about to do and consider the possible outcomes so that you do not regret outcomes that may not make your day.

Unfortunately some do not become experienced until they have experienced a situation themselves and often that is too late.

Take care out there

http://raanz.org.nz/recpilot/RecPilot%20issue%20133.pdf

Appendix 5: Resources and references

Air Accident Investigation Branch, UK. Bulletins 6/2007 G-BIGU; 8/2010 BIPY; 6/91 G-BRZM; 2/94 G-BOYK, 12/2002 G-INCH; 1/2001 G-BXDC https://www.gov.uk/aaib-reports

Civil Aviation Authority, 2010. *CAA Paper 2009/02: The Aerodynamics of Gyroplanes*. Civil Aviation Authority, West Sussex. United Kingdom. https://publicapps.caa.co.uk/docs/33/Paper2009_02red.pdf

Civil Aviation Authority of New Zealand, 2013. *Medical Information Sheet 016 Depression (MIS016)*. http://www.caa.govt.nz/assets/legacy/medical/Med_Info_Sheets/MIS016.pdf

Civil Aviation Authority of New Zealand. Fatal accident reports https://www.caa.govt.nz/accidents-and-incidents/fatal-accident-reports/

Civil Aviation Authority of New Zealand. Safety publications https://www.caa.govt.nz/safety-info/publications/

Federal Aviation Administration, 2000. Chapters 15-21 *Rotorcraft Flying Handbook FAA-H-8083-21.* U.S. Department of Transportation, United States of America. https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/media/faa-h-8083-21.pdf

Flying New Zealand website http://www.flyingnz.co.nz/

New Zealand Auto Gyro Association website http://www.gyroplane.org.nz/

Recreational Aircraft Association New Zealand website http://raanz.org.nz/wiki/pmwiki.php

Sport Aviation Corp website http://www.sportflying.co.nz/

About the CAA

New Zealand's legislative mandate to investigate an accident or incident, are prescribed in the Transport Accident Investigation Commission Act 1990 (the TAIC Act) and Civil Aviation Act 1990 (the CA Act).

Following notification of an accident or incident, TAIC may conduct an investigation. CAA may also investigate, subject to Section 72B(2)(d) of the CA Act which prescribes the following:

> **72B Functions of Authority**
>
> (2) The Authority has the following functions:
>
> (d) To investigate and review civil aviation accidents and incidents in its capacity as the responsible safety and security authority, subject to the limitations set out in section 14(3) of the Transport Accident Investigation Commission Act 1990

The purpose of a CAA safety investigation is to determine the circumstances and identify contributory factors of an accident or incident with the purpose of minimising or reducing the risk to an acceptable level to prevent a similar occurrence arising in the future. The safety investigation does not seek to ascribe responsibility to any person but to establish the contributory factors of the accident or incident based on the balance of probability.

A CAA safety investigation seeks to provide the Director of Civil Aviation with the information required to assess which, if any, risk-based regulatory intervention tools may be required to attain CAA safety objectives.

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OR

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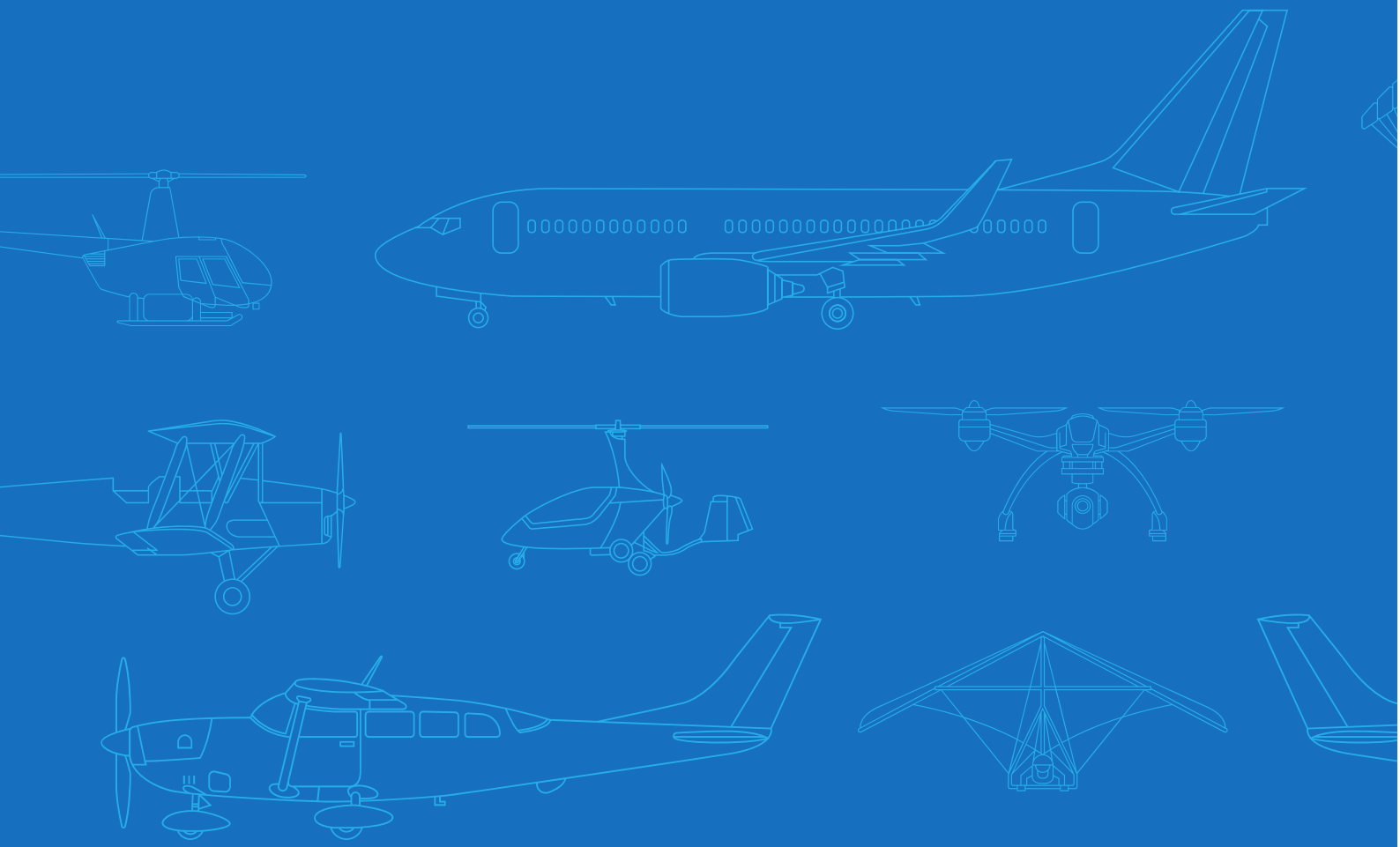

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