

Loss of Control Inflight (LOC-I)

Investigation Report

Accident Zlin Z 242 L B-LUK Ma Shi Chau, Hong Kong 24 June 2018

IVR-2025-01

AAIA Investigations

Pursuant to Annex 13 to the Convention on International Civil Aviation and the Hong Kong Civil Aviation (Investigation of Accidents) Regulations (Cap. 448B), the sole objective of the investigation and the Investigation Report is the prevention of accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

The then Chief Inspector of Accidents-cum-Director-General of Civil Aviation ordered an inspector's investigation into the accident in accordance with the provisions in Cap. 448B. As the powers of accident investigation were transferred to the Air Accident Investigation Authority (AAIA) with effect from 10 September 2018, the investigation of the accident was carried on by AAIA.

This accident investigation report contains information of an occurrence involving a Zlin Z 242 L, Registration B-LUK, operated by the Hong Kong Aviation Club (HKAC), which occurred on 24 June 2018.

The HKAC, National Transportation Safety Board (NTSB), Bureau of Enquiry and Analysis for Civil Aviation Safety (BEA) and the Civil Aviation Department (CAD) provided assistance to the investigation.

Unless otherwise indicated, recommendations in this report are addressed to the regulatory authorities of the State or Administration having responsibility for the matters with which the recommendation is concerned. It is for those authorities to decide what action is taken.

This Investigation report supersedes all previous Preliminary Report and Interim Statements concerning this accident investigation.

All times in this Investigation Report are in Hong Kong Local Times unless otherwise stated.

Hong Kong Local Time is Coordinated Universal Time (UTC) + 8 hours.

Chief Accident and Safety Investigator

Air Accident Investigation Authority

Transport and Logistics Bureau

Hong Kong

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Synopsis

On 24 June 2018, the pilot of Zlin Z 242 L aircraft, registered B-LUK, took off from Shek Kong Airfield (VHSK) at approximately 1629 hrs intending to conduct a local flight in the Tolo Harbour area approximately ten miles to the north east.

The aircraft was operated under Visual Flight Rules (VFR) with no passengers on board. The pilot reported to Hong Kong Information entering the Tolo Harbour area at 1632 hrs.

The accident occurred at approximately 1635 hrs when the pilot lost control inflight and the aircraft impacted terrain on Ma Shi Chau, an island in Tolo Harbour.

Between 1639 and 1649 hours, the Hong Kong Police Force (HKPF) received multiple reports of an aircraft crash mid-way up the slope of Ma Shi Chau. One of these reports came from the pilot himself. Air Traffic Control (ATC), Fire Services Department (FSD) and the Government Flying Service (GFS) were alerted by HKPF. ATC also notified the Accident Investigation Division (AID) of the CAD shortly after the accident.

The pilot suffered minor head injuries but was able to evacuate from the aircraft.

Members of the public who witnessed the accident and the Marine Police arrived to the scene and located the injured pilot at 1651 hrs. The injured pilot was sent to Tai Mei Tuk Pier by police vessel. He received initial medical treatment from ambulance personnel and was subsequently sent to hospital for treatment.

The report makes two safety recommendations.

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1. FACTUAL INFORMATION

1.1. History of the Flight

1.1.1. **Pre-flight Preparation**

- (1) On 24 June 2018, a Zlin Z 242 L aircraft, registration B-LUK, was operated on a private flight under VFR from the HKAC at Shek Kong Airfield (VHSK) to New Town, Tolo and Mirs Bay via the Kadoorie Gap (KDG).
- (2) The pilot completed and sent a VFR Local Flight Notification Form¹ at 1550 hrs with flight details, i.e. depart from VHSK to KDG NEW TOL MBY TOL NEW with KDG as destination, to ATC. ATC telephoned the pilot to clarify VHSK was the destination before the flight.
- (3) The pilot was not on the HKAC self-authorizing pilot list² so it was necessary to obtain authorisation for the proposed flight from a flying instructor (FI) and for this to be endorsed on the Flight Authorisation Log (FAL). He obtained the authorization for the flight at around 1615 hours. The authorizing FI noted the pilot wrote "Sectors" on the FAL.
- (4) The flight plan and intended route was not shown to the authorizing FI, and the pilot was not queried about his intentions. Except for the area the pilot intended to fly in, there was no guidance for the FI to ascertain what the pilot intended doing during the flight. It was ascertained after the accident that the pilot intended to practise stalls, incipient spins and steep turns.
- (5) The pilot completed the pre-flight documentation including reading the Notice to Airmen (NOTAM). The pilot then signed the Engine Failure after Take-Off (EFATO) Form³, which indicated that the pilot had self-briefed and understood the EFATO procedures before the flight.

1.1.2. The Accident Flight

(1) The aircraft departed from Shek Kong Airfield at about 1629 hrs with the pilot as the only occupant.

¹ Visual Flight Rules (VFR) Local Notification Form – Filed with ATC for local flights.

² Self-Authorising List: contains the names of those pilots whom the HKAC considers competent enough to authorise their own flights.

³ EFATO Engine Failure After Take-Off form. Due to the lack of suitable areas and encroaching construction activity in the vicinity of the airfield, the briefing and aerial photographs are updated regularly, indicating areas suitable for a landing in the event of an engine failure.

- (2) When the aircraft was at about 2 200 ft Above Mean Sea Level (AMSL) at Tolo, after completing a HASELL⁴ check the pilot practised a stall. As the aircraft entered into the stall, the pilot applied left rudder with the intention to induce an incipient spin. The aircraft yawed to the left and commenced to bank left.
- (3) The pilot started applying full right rudder to recover when the aircraft was approximately in a 45-degree left bank. The yaw and bank did not cease and the manoeuvre developed into a fully developed spin. The pilot kept applying full right rudder and put the control stick at neutral but the spin continued. The pilot then pushed the control stick forward and kept the ailerons neutral in an attempt to recover. The aircraft then impacted terrain on Ma Shi Chau (Figures 1 & 2).
- (4) The pilot sustained minor head injuries but was able to evacuate from the aircraft and reported the accident to the authorities.



Figure 1: Accident Location at Ma Shi Chau

⁴ A standard mnemonic to prompt a series of checks prior to carrying out manoeuvres such as a stall. The HASELL acronym stands for Height, Airframe, Security, Engine, Location & Lookout.



Figure 2: Close-up of the Accident Location

1.1.3. Witness Information

- (1) A witness from Tai Mei Tuk Pier observed the aircraft descending vertically in several circular motions over Ma Shi Chau and later it disappeared behind the hilltop of Ma Shi Chau.
- (2) Another witness from a Ma Shi Chau fish farm noticed the aircraft was flying towards the hilltop of Ma Shi Chau. The witness stated that before the impact, the aircraft was not rotating and flying with the nose pitching up.
- (3) The pilot provided the investigation team with an oral and written statement relating to his actions on this flight which are referred to in the report.

1.2. Injuries to Persons

There was one pilot on board the aircraft. The pilot suffered minor head injuries.

Injuries to Persons						
Persons on board:	Crew	1	Passengers	0	Others	0
Injuries	Crew	1	Passengers	0		

Table 1: Injuries to Persons

1.3. Damage – Aircraft

(1) As a result of the impact, the aircraft suffered major damage. The right wing of the aircraft was severely damaged with the outboard auxiliary fuel tank driven upward (Figure 3). The bottom leading edge surfaces of the right wing, the aileron had impact damage. The left wing was relatively intact with impact damage on wing tip and aileron (Figure 4). There was a fuel leak from the distorted main fuel tank. The aft fuselage remained intact. The right empennage area had impact damage (Figure 5).



Figure 3: Right Fuselage and Wing



Figure 4: Left Wing



Figure 5: Right Empennage

(2) The engine bay area was damaged and the engine mounts were distorted (Figure 6). Two of the three propeller blades were shattered and the third was damaged at the tip (Figure 7).



Figure 6: Engine Bay

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Figure 7: Propeller

(3) The details are included in Section 1.12.

1.4. Other Damage

An area of vegetation at the accident site measuring 5 by 10 meters was destroyed.

1.5. Personnel Information

The pilot held a valid licence and medical certificate. His information is in Section 6.2.

1.6. Aircraft Information

1.6.1. Aircraft

- (1) The Zlin Z 242 L aircraft is manufactured in the Czech Republic. It is a twoseat, single-engine low-wing monoplane of all-metal structure with a tricycle fixed landing gear. It is designed for basic and advanced training, and is certified to perform aerobatic manoeuvres of +6 / -3.5 g.
- (2) The aircraft has a Type Certificate from the CAD as well as the European Aviation Safety Agency (EASA) and the Federal Aviation Administration.

- (3) The CAD issued a Certificate of Registration (DCA 559) to B-LUK on 25 August 2017 and a Certificate of Airworthiness (DCA 958) on 14 November 2017 valid until 13 November 2018.
- (4) Prior to the accident flight, it had a total time in service of 153.3 hours with 145.3 engine hours, the discrepancy being attributed to the incorrect initial setup of the engine hour meter.

1.6.2. Engine

A Textron Lycoming AEIO-360-A1B6 fuel injection piston engine driving a three bladed constant speed propeller is fitted. The four-cylinder engine is air-cooled and produces a maximum of 200 HP. The propeller blades are made of wood with a composite skin and the surface is coated with acrylic varnish.

1.6.3. Maintenance History

- (1) The aircraft had a valid maintenance release showing no outstanding issues after the latest 50-hour maintenance inspection on 7 June 2018.
- (2) Prior to the accident flight, the aircraft records indicated no outstanding defects.

1.6.4. Fuel On Board

- (1) According to the record provided by the HKAC, a total of 49 litres of aviation gasoline (AVGAS) 100LL fuel was uplifted to the accident aircraft at 1546 hours on 24 June 2018. The accident flight was the third flight of the day.
- (2) Although there was no record of the total fuel on board the aircraft before the accident flight, HKAC records indicated that 49 litres of fuel were uplifted before the second flight which was conducted for a period of 30 minutes. Based on the estimated fuel usage, there should have been sufficient fuel for the subsequent "one-hour" flight booked by the pilot.
- (3) Fuel samples from the HKAC fuel storage tank at Shek Kong Airfield and the aircraft were collected and sent for laboratory analysis. The AVGAS 100LL samples from the aircraft fuel tank and Shek Kong Airfield met the testing requirements of Shell Internal Fuels Technical Data Sheet.

1.6.5. Mass and Balance

(1) There is no evidence that a calculation was completed prior to departure.

(2) Based on the calculation by the investigation team, it is estimated that the aircraft was within the allowable weight and balance limits during the flight.

1.6.6. Acceleration Monitoring Unit (AMU)⁵

The data from AMU1.01 S/N 196 of the aircraft was downloaded and analysed by SPEEL PRAHA Ltd in Prague. The report of the "aircraft safe life time evaluation" indicated that the aircraft total safe life was at 96.77% when the AMU information was evaluated to the date of 24 July 2018.

1.7. Meteorological Factors

1.7.1. Weather Forecast for Local Aviation

The Hong Kong Observatory (HKO) issued a Weather Forecast for Local Aviation at 1230 hrs for the period from 1300 hrs to 2300 hrs:

- (1) Surface wind: 150° at 10 knots, temporarily variable wind speed 15 knots with gust 25 knots in thunderstorms. Offshore 150° at 15 to 20 knots. Temperature: Offshore 34°C to 28°C.
- (2) Weather: Sunny periods. There will also be a few showers and isolated thunderstorms.
- (3) Cloud (AMSL): Few clouds at 1 500 ft, scattered cloud at 3 000 ft, temporarily few cumulonimbus cloud at 1000 ft, scattered cloud at 1 500 ft and broken cloud at 4 000 ft.
- (4) Visibility: 10 kilometres (KM) temporarily reducing to 3 500 meters (M) in showers, temporarily reducing to 2 000 M in thunderstorms.
- (5) Further Outlook: Moderate southerly winds. Mainly cloudy with isolated showers.

1.7.2. Experimental Regional Weather Information

(1) The HKO provides "Experimental Regional Weather Information" to HKAC pilots with supplementary weather forecast information. The forecast wind direction and speed, general weather and visibility at Shek Kong and Tolo from 1500 to 1800 hrs on 24 June 2018 were provided indicating light winds and good visibility.

⁵ The aircraft is fitted with an Acceleration Monitoring Unit (AMU) to record the vertical acceleration and other airframe stress during aerobatic manoeuvres in order to monitor fatigue.

(2) The weather in the vicinity of Ma Shi Chau closest to the accident time was captured by the HKO camera at Tolo Harbour (Figure 8).



Figure 8: HKO Weather Camera Tolo Harbour at 1634 hrs on 24 June 2018

1.8. Navigation Aids

Ground-based navigation aids and aerodrome visual ground aids were not a factor in this accident. The accident flight was operating under VFR during which the aircraft was required to remain clear of cloud and in sight of the surface.

1.9. Communications

1.9.1. Very High Frequency Radio (VHF)

- (1) The aircraft was equipped with VHF radio communication systems. All VHF radios were serviceable. All communications between Hong Kong ATC and the pilot were recorded by the ATC Voice Recording System.
- (2) The pilot maintained radiotelephony (RT) communication with ATC on the designated Hong Kong Information VHF frequency 121.0 MHz.
- (3) The last RT communication received by ATC from the pilot was at 16:32:53 hrs when the aircraft was entering the Tolo area.

- (4) After the accident, the pilot transmitted several MAYDAY calls on 121.0 MHz. There was no response, but the pilot could hear transmissions between ATC and other aircraft. The pilot was unable to change the frequency to 123.6 MHz⁶ because the touchscreen on the radio panel was not working.
- (5) The pilot also selected 7700^7 on the transponder.

1.9.2. Emergency Locator Transmitter (ELT)⁸

After the impact, the pilot stated that, to ensure the ELT was activated, he recycled the ELT switch on the remote control panel in the cockpit from 'ARMED' to 'OFF' and 'ON' again.

1.9.3. Personal Electronic Device (PED)

The pilot used his mobile phone to call police for assistance after he had evacuated from the aircraft at 1647 hrs.

1.10. Aerodrome Information

1.10.1. Remote Accident Site

- (1) The accident occurred at Ma Shi Chau approximately nine nautical miles to the north east of the departure aerodrome.
- (2) The information on the departure and the destination aerodrome is listed in Section 6.4.

1.11. Flight Recorders

- (1) The aircraft was not equipped with a flight data recorder (FDR), a cockpit voice recorder (CVR) or an airborne image recorder (AIR).
- (2) The current regulations do not stipulate that this category of aircraft shall be equipped with a FDR or a CVR. In addition, this category of aircraft is not required to have an AIR device installed, which can capture the general

⁶ Shek Kong Airfield ATS (Air Traffic Service) communication frequency.

⁷ Selection of 7700 on the transponder indicates an 'Emergency'.

⁸ An Emergency Locator Transmitter (ELT) is a device which transmits a distress signal that can be detected to aid search and rescue (SAR). It can be activated either manually or automatically by impact.

cockpit environment, non-verbal flight crew communications, flight crew workload and activity, and status of instrumentation.

1.12. Wreckage and Impact

1.12.1. Aircraft

- (1) The aircraft suffered major damage.
- (2) Both the upper and lower cowls were damaged with the underside showing extensive vegetation score marks. The left side cowling was punctured due to a tree branch.
- (3) The lower firewall was damaged and the engine mounts distorted and bent.
- (4) The spinner was crushed. Two propeller blades were splintered approximately midway along their diameter with the third blade's outer portion intact.
- (5) Both wing leading edges and the fairings at the wing roots were damaged.
- (6) Impact scoring under fuselage were noted below the cabin area.
- (7) The leading edge of the right stabilizer was damaged and the right elevator undersurface was punctured.
- (8) Both main wheel fairings were damaged with the left main undercarriage bent inwards toward the fuselage.
- (9) The pitot head and wing attachment was bent flat, flush to the under wing surface.
- (10) In the cockpit, the throttle was found to be in the idle position with the propeller pitch and mixture controls in the forward position.

1.12.2. Engine

- (1) Engine examination and test runs were conducted at the Lycoming Factory in the United States of America on 25 March 2019, under the supervision of the NTSB.
- (2) There was impact-related damage observed to Nos. 2 and 4 induction pipes in the form of dents on the lower side of each pipe. The No. 4 induction pipe was deformed along its attach flange to the cylinder head and pushed inwards on the opposite end of the pipe into the sump housing.

- (3) A lighted borescope inspection of each cylinder revealed rust on the cylinder walls but no other anomalies. An initial thumb-compression check was completed by rotating the engine through the propeller flange. There was compression on all four cylinders. The magneto-to-engine timing was at 23° before top-dead-centre on both magnetos. A crankshaft runout test revealed no bending or damage to the propeller flange. The oil filter was cut open and its paper filter element did not contain any metallic debris.
- (4) The engine was test run using the Lycoming new engine test specifications. The engine demonstrated the ability to develop rated horsepower during the test runs.
- (5) The engine examination and subsequent test runs did not identify any preimpact mechanical malfunctions that would have precluded normal operation during the accident flight.

1.13. Medical/Pathological Information

- (1) No medical or pathological investigations were conducted as a result of this occurrence, nor were they required.
- (2) The pilot sustained minor head injuries and remained conscious. The pilot was discharged from hospital on 26 June 2018.

1.14. Smoke, Fire, and Fumes

The aircraft did not catch fire after the impact.

1.15. Survival Aspects

1.15.1. Pilot Evacuation

- (1) The aircraft cockpit remained intact and provided a survivable space.
- (2) The five-point safety harness remained attached to the respective mounting points and secured the pilot during the impact.
- (3) The pilot reported that it was difficult to open the canopy initially. The pilot then pulled the canopy jettison handle and was able to vacate the aircraft.

1.15.2. Search and Rescue

(1) The accident was reported to the Police between 1639 hrs and 1641 hrs by ten witnesses who had observed the aircraft descending vertically in

several circular motions over Ma Shi Chau and then impacting on the hill slope of Ma Shi Chau. The FSD, after being notified by the Police at 16:39:52 hrs immediately alerted the CAD and the GFS.

- (2) ATC then requested assistance from a Cessna 172 (B-HPL) and a Robinson 22 (B-LOV) operating at Tolo to search for the accident aircraft during the time from 16:40:12 hrs to 16:58:39 hrs.
- (3) The pilot informed the Police by mobile phone about the accident after evacuating from the aircraft at 1647 hrs. A Police Launch arrived at Ma Shi Chau at 1654 hrs, and the Police located the pilot and the aircraft at 1659 hrs with assistance from workers at a nearby fish farm.
- (4) The GFS was advised at 1654 hrs concerning search operations at Ma Shi Chau. The GFS helicopter took off at 1702 hrs and was informed by the Police at 1716 hrs that both the pilot and the aircraft were located.
- (5) The pilot was assisted downhill to the shore by members of the public and the Police at 1707 hrs. The pilot initially received medical treatment by ambulance personnel prior to being transported to hospital.

1.15.3. Emergency Locator Transmitter (ELT) Signal

- (1) The aircraft was equipped with a Kannad 406 AF-COMPACT ELT manufactured in France. The ELT is fitted behind the right hand seat and is accessed by an inspection panel. It has 'ARM', 'OFF' and 'ON' switch selections and is connected via a remote control toggle switch in the cockpit with 'ON', 'ARMED' and 'TEST/RESET' positions.
- (2) The Hong Kong Maritime Rescue Co-ordination Centre (HKMRCC) received the 406 MHz ELT's first transmission at 0658 on 25 Jun 2018⁹. The duty operator faxed the alert message to ATC at 0702 on 25 June 2018. ATC confirmed the alert was from B-LUK.
- (3) There were no reports of the 121.5 MHz ELT transmission by overflying aircraft after the accident.

1.16. Tests and Research

1.16.1. Emergency Locator Transmitter (ELT)

(1) As there were no transmissions on 121.5 MHz heard by overflying aircraft and the first transmission on 406 MHz was received at 0658 hrs the

⁹ The time lapse of ELT signal reception by HKMRCC was investigated with the assistance from the manufacturer.

following day, the ELT was sent to the manufacturer and tested under the auspices of the BEA.

- (2) The investigation report from the manufacturer after the tests were carried out showed that the ELT had been on for several hours prior to their investigation. The manufacturer's investigation could not conclude when the ELT had been on, but only on how long it had been on.
- (3) The test was unable to ascertain when the ELT was switched off or on again.

1.17. Organisation, Management, System Safety

1.17.1. Civil Aviation Department (CAD)

- (1) The CAD is the issuing authority of pilot licences and ratings as per the Air Navigation (Hong Kong) Order (Cap. 448C).
- (2) The CAD publishes the policy document "Requirements Document: Pilot Licences and Associated Ratings" (CAD 54)¹⁰ for the grant and renewal of flight crew licences and associated ratings under Cap. 448C.
- (3) The CAD regulates the HKAC pilot members engaging in flying activities in accordance with the applicable provisions and regulations. Where "flying club" is referred to in Cap. 448C, they may be applicable to the HKAC.
- (4) Certificate of Experience and / or Certificate of Test are issued to HKAC pilots. Private Pilot's Licence (Aeroplane) (PPL(A)) flight tests are carried out by CAD Authorized Examiners (AE).
- (5) The CAD issues a Certificate of Registration and a Certificate of Airworthiness to HKAC aircraft.
- (6) The CAD advises the HKAC on their activities to promote safety and ensure they conform to the requirements of Cap. 448C. The CAD has a Hong Kong Aviation Safety Programme (HKASP) to introduce performance based regulatory elements in safety oversight to focus on relatively higher risk areas based on all available information, and seek assurance that those risks are proactively mitigated through effective means. "Smaller" aircraft accident prevention is one of the safety indicators under the HKASP.

¹⁰ CAD 54 Revision 14 (April 2011) is referred to in the report.

1.17.2. Hong Kong Aviation Club

The HKAC is a private member's club operating from Shek Kong Airfield. The day-today operations are managed by its operations staff under the direction of a General Committee.

The HKAC conducts flying training courses for the issue of a PPL(A) and Assistant Flying Instructor (AFI) ratings. Applicants for the issue of a PPL(A) in Hong Kong have to meet the licencing requirements published in CAD 54.

1.17.2.1. PPL(A) Training Syllabus

- (1) On 5 March 2014, the HKAC requested the CAD to evaluate the PPL(A) syllabus published by Pooleys Flight Equipment Ltd. This syllabus adapted the United Kingdom based Aircraft Owners and Pilots Association (AOPA) European Joint Aviation Requirements for Flight Crew Licences (JAR-FCL) published by Pooleys Flight Equipment on behalf of AOPA ("Pooley's").
- (2) The investigation team obtained a copy of the Pooley's syllabus from the CAD. The syllabus proposed several changes, including shortening the instrument flying (IF) hour from 8 hours to 4.5 hours and introducing a spin avoidance exercise to substitute the spin recovery one that was no longer required.
- (3) The CAD accepted the proposed amendment to the PPL training requirements ("revised requirements") on 1 September 2014, including the substitution of the full spin recovery with the spin avoidance exercise (stalling and recovery at the incipient spin stage). According to the information provided by CAD, the Personnel Licensing Office (PELO) of CAD had since adopted the revised requirements for the granting of the PPL(A), including the pilot in this accident.
- (4) HKAC adopted "Pooley's" as the PPL(A) Training Syllabus in September 2014. However, they did not document the accepted syllabus in the General Flying Orders of the HKAC.
- (5) The investigation team considered that the change of the IF syllabus from 8 to 4.5 hours had no bearing on the accident of this flight.

1.17.2.2. Full Spinning Exercise

(1) As agreed between the CAD and the HKAC in September 2014, full spin entry and recovery was removed from PPL(A) training syllabus.

(2) Spinning is no longer required to be demonstrated by instructors during training, and has been replaced by an incipient spin exercise. Full spinning exercises are covered in aerobatic training, and restrictions on spinning are stated in the aircraft's Airplane Flight Manual (AFM).

1.17.2.3. Incipient Spin Exercise

- (1) The emphasis of the incipient spin exercise is on recognition and recovery at the incipient stage, without entry into a fully developed spin. The exercise is demonstrated by the FI and the student pilot is required to follow through on the recovery actions. Student pilots are not required to conduct the exercise.
- (2) The HKAC lesson plan / briefing materials (PowerPoint slide) on incipient spin does not specify whether the student has to perform the procedures hands-on or just observe the FI demonstrating the manoeuvre.
- (3) Under GFO-06 Stalling, Spinning & Aerobatic Manoeuvres, spinning and aerobatics are addressed under separate sections. GFO-06 also specifies relevant limitations for Zlin Z 242L and Slingsby type aircraft but not Cessna aircraft.
- (4) Paragraph 2 a) of the GFO-06 which was valid at the time of the accident reads "Spinning exercises may only be conducted under the supervision of an instructor except for aerobatic pilots who are cleared for solo spinning".
- (5) Paragraph 2 c) indicates that a two turn spin in a Zlin should be entered at a height of not less than 4 600 ft AGL
- (6) Paragraph 2 d) states that "*Recovery from incipient spin may be entered minimum altitudes set out in 1 (b) above* (2000 ft AGL PPL (A) recovery height for stalling exercises) *plus 1000 ft*" which indicates a recovery to be commenced at 3000 ft AGL.¹¹

1.17.2.4. Personal Flying Log Book

(1) A Personal Flying Log Book, CAD 407, is to be kept up-to-date and produced as and when required by CAD in connection with the grant, renewal or variation of the privileges of a flight crew licence under Article 22 of Cap. 448C.

1.17.2.5. Requirements for a Type Conversion

CAD 54 sets out the privileges of PPL(A) Group A rating which entitles the holder to act as Pilot-in-Command (PIC) of all single-engine aeroplanes not exceeding 5 700 kg

¹¹ GFO-06 dated 1 April 2014

total weight, which is in accordance with the 'Class Ratings' provisions in ICAO Annex 1. There are no specific requirements for type conversion within the same aircraft group.

1.17.2.6. Zlin Z 242 L Airplane Flight Manual

- (1) Before conducting a flight, the pilot, as detailed in Section 1, Article 1.1. on page 1-3 of the AFM, is required to be familiar with the contents of the Manual, including all Supplements.
- (2) Spin recovery procedures are provided in Section 4 Normal Procedures, Article 4.18 on pages 4-23 and 4-24 of the AFM. The altitude loss following a spin recovery is quoted as:¹²
 - 1 turn before recovery approximate 1150 ft
 - 3 turns before recovery approximate 1650 ft
 - 6 turns before recovery approximate 2300 ft
- (3) There is no provision for "incipient spinning" in the Manual.
- (4) Spin recovery procedures are also notated on a decal affixed to the forward left hand side of the cockpit canopy.

1.17.2.7. Operations & Relevant General Flying Orders

- (1) To ensure members are conversant with their responsibilities, the HKAC issues and implements GFOs, which are mandatory requirements issued by the Chief Flying Instructor (CFI) for all pilots operating aircraft owned by the HKAC and private owned aircraft based at the HKAC.
- (2) The CAD has no legal jurisdiction regarding the GFOs, however, as part of the CAD safety oversight recommendations, pilots are to review the GFOs at least once every 12 months or whenever a new order is published and sign that they have understood the contents.
- (3) GFO-06 states in 2 a) "Spinning exercises may only be conducted under the supervision of an instructor except for aerobatic pilots who are cleared for solo spinning".

1.17.2.8. Authorisation of Flight

(1) A Flight Authorization Form is required to be completed by pilots operating from Shek Kong Airfield.

¹² Section 4.18.1 Zlin Z 242 L Airplane Flight Manual

- (2) As a requirement of GFO-13 Authorisation of Flights¹³, student pilots and new PPL holders, who are not 'self-authorised' to conduct solo flights, are required to complete a Flight Authorization Form.
- (3) Pilots in this category must be authorised and supervised by an AFI or FI. The authorization is made by an instructor by signing off the proposed flight entered in the aircraft FAL by the pilot.
- (4) Authorization is based on the weather conditions as stipulated by the HKAC's Shek Kong Operation Instructions SKOI-614 "Weather Minima for VFR flights during Daylight Hours".
- (5) There were no specific requirements in the GFO-13 for the pilot to communicate his intentions to the authorising instructor or to present the flight plan for authorization.
- (6) The GFO-13 did not provide any guidance for the FI to ascertain the pilots' intentions during the flight.

1.18. Additional Information

1.18.1. Accident Pilot Training

1.18.1.1. Private Pilot's Licence (Aeroplanes) (PPL (A)) Training

The pilot received training for the PPL(A) on Cessna C172 aircraft at the HKAC during the period from 23 October 2016 to 20 February 2018 in Hong Kong. He passed the PPL(A) Flight Test on 24 February 2018.

1.18.1.2. HKAC Training Documentation

- (1) According to HKAC, "Pooley's" was adapted as the PPL(A) Training Syllabus in September 2014. A copy of the training syllabus that was effective during the pilot's PPL(A) training with HKAC between October 2016 and February 2018, while the pilot was receiving PPL(A) training with the club, was not available.
- (2) The "Pooley's" PPL syllabus is structured in such a way that the lessons and exercises have reference numbers, i.e. Exercise 11.1 is 'To enter and recover from an incipient spin'.

¹³ GFO-13 dated 1 Nov 2013

¹⁴ The Shek Kong Operation Instructions (SKOI) forms the basis of acceptance of the PPL syllabus and it is not to be amended without the consent from CAD.

- (3) Inconsistency of some training record entries were observed in the pilot's SPR, PPL lesson record and personal flying log book. The pilot commenced his PPL(A) training with HKAC in October 2016. The HKAC Student Pilot's Record (SPR) and HKAC PPL(A) Lesson Record did not reflect the updated information of the "spin avoidance exercise".
- (4) For example, on 12 February 2017 referring to Figure 9 the instructional exercise was logged and signed off on the SPR as Exercises 10b2, 12 and 13. Exercise 10(B)2 refers to stall recovery and 12 and 13 pertain to take-off and landing manoeuvres.

	11114	.4.5	1	10-0		15402
PL	5.2.17	12/13	07	15.5	gon destablent to goal the sunk	HUR
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UV	12/2/17	10.12,12,13	0.8	16.3	STALL accord, very good thirt . Neved to directive intodaway Checklist note. Tend to flave a little	-
					to verngence & content.	CV.
un	20/2/17	10a,106	0.8	171	Reviewed Topot Climb: A.F.T 1	7427

Figure 9: Student Pilot's Record

(5) Referring to Figure 10, for the same flight, in the PPL lesson record, Exercise 11(A) "*Incipient Spin Recovery*" along with 10B(1) and 10B(2) was signed off.

9	Medium Turns	J1 17477 105017
10(11)	Con Play	
10(B)1	Stall Recovery 1.	12-86817
10(B)2	Stall Recovery 2.	1.0017
11(A)	Incipient Spin Recovery. (Brief Inc. In 10B (1) (2))	Final (1-mart)

Figure 10: Lesson Record

(6) Referring to Figure 11, also the same flight, the exercise was entered in the pilot's personal flying log book as "*Stall with power*" and "*Stall with flaps*" with no entry regarding the incipient spin recovery lesson.

2017	C172R	B- HPL		Self	P/UT Circuits
2017	101-0	2 1101	1 1	Dar	
2017				Gen	Approach
2/12	C172R	B-LWV		Self	PUT stall with slaps
2017	61770	D Lat	TV	C. Cr	
				Voici	The second

Figure 11: Pilot's Personal Logbook

(7) For a flight on 25 February 2018 after the PPL Flight Test, Exercises 10 and 11 (2 full spins and 1 hour of stall and spin, not spin awareness and avoidance) was recorded in the HKAC SPR by the instructor. The exercise was recorded as "*1 hour stall*" in the pilot's personal flying log book.

1.18.1.3. PPL(A) Application

- (1) After passing the PPL Flight Test, the pilot submitted the Hong Kong Civil Aviation Department Private Pilot's Licence (Aeroplanes) Initial Issue / Renewal / Aircraft Rating (DCA 528/PPL(A)) form together with CAD 407, the pilot's personal flying log book to the CAD PELO on 16 March 2018.
- (2) The PELO issued a Private Pilot's Licence (Aeroplanes) to the pilot on 23 March 2018.
- (3) The licence was endorsed for Group A All single-engine aeroplane (landplanes) of which the maximum total weight authorised does not exceed 5 700 kg, and a valid medical certificate. This included an Aircraft Rating – Certificate of Test on Cessna C172 type aircraft with validity from 24 February 2018 to 23 March 2019.

1.18.1.4. Stall and Spin Awareness and Avoidance Training

- (1) Full spin training is not required for the issue of a PPL(A). The pilot had accumulated 2.3 hours of "stall and spin awareness and avoidance training" before the PPL Flight Test on 24 February 2018 (comprising 2 hours of stall exercise and 0.3 hour of incipient spin recovery exercise).
- (2) The pilot booked a Cessna C152 (C152) for a dual flight on 25 February 2018 for flying skill enhancement and additional training hours on "stall and spin awareness and avoidance" after the PPL Flight Test.
- (3) The C152 flight on 25 February 2018 was, according to the pilot, the only time that he had practised full spin recovery. The pilot was able to recollect the recovery action of an incipient spin from the Cessna AFM and the training exercise on 12 February 2017 to the investigation team.

1.18.1.5. Zlin Z 242 L Conversion

- (1) The pilot had five dual flying training sessions on the Zlin between 15 April 2018 and 16 June 2018. The pilot was cleared to fly Zlin aircraft after the fourth conversion training flight on 10 June 2018.
- (2) The accident flight on 24 June 2018 was the pilot's first pilot-in-command flight in a Zlin. The pilot had not been trained nor authorised to conduct incipient spins or spins in a Zlin.

1.18.1.6. Compliance with HKAC General Flying Orders

- (1) The pilot had signed a "GFO Annual Review Form (dated 1 April 2018)" and an "Emergency Action Plan - 6 Months Review Form (dated 1 April 2018)" to indicate he had reviewed and understood the HKAC's orders and instructions.
- (2) GFO 06 Stalling Spinning & Aerobatic Manoeuvres dated 1 April 2014 stated that the minimum abandonment height for spinning in a Zlin Z 242 L was 3 000 ft and indicated for example that a two turn spin should be entered at a height of not less than 4 600 ft AGL.

1.18.2. Aircraft Spinning

- (1) A spin is a special category of stall resulting in autorotation about the vertical axis and a shallow, rotating, downward path. Spins can be entered intentionally or unintentionally, from any flight attitude if the aircraft has sufficient yaw while at the stall point.
- (2) Spin training is not a requirement by many regulators for pilot training and is the source of considerable debate. There is a contention that few stall/spin accidents occur at altitudes where a spin-proficient pilot could affect complete recovery, and teaching people to avoid spins in the first place is a better means of avoiding accidents than teaching pilots to recover from them.
- (3) In line with this contention, spinning is no longer part of the syllabus for the HKAC flying course. The emphasis is now placed on pilots being taught how to avoid a stall/spin flight condition.
- (4) In a normal spin, the wing on the inside of the turn stalls while the outside wing remains flying. It is possible for both wings to stall, but the angle of attack of each wing, and consequently its lift and drag, are different.
- (5) Either situation causes the aircraft to autorotate toward the stalled wing due to its higher drag and loss of lift.
- (6) Spins are characterized by high angle of attack, an airspeed below the stall on at least one wing and a shallow descent.
- (7) Recovery may require a specific and counter-intuitive set of actions by the pilot.

1.18.3. Aircraft Spin - Stages and Recovery

- (1) Incipient Stage
 - This stage is generally driven by pilot inputs.
 - This is the transitional stage, during which the aircraft progresses from a fully developed stall into autorotation.
 - This progression may be very rapid and may last only two turns, during which time the rotation tends to accelerate towards the rate found in the developed stage.
 - As a very general rule, if spin inducing control inputs are removed at this stage then the aircraft will recover.
- (2) Development Stage
 - At this stage, the spin will be self-perpetuating as a state of equilibrium is reached.
 - It is characterised by a low and constant airspeed. Rates of descent will be as high as 5 000 to 8 000 ft per minute.
 - If the pilot does nothing about it, the spin is likely to continue until the aircraft hits the ground.
 - Positive anti-spin control inputs will be required to recover from the fully developed spin.
- (3) Recovery Stage
 - Spinning ceases only if and when opposing forces and moments overcome autorotation.
 - Since yaw coupled with roll powers the spin, the pilot must forcibly uncouple them by applying full opposite rudder.
- (4) Spin Recovery
 - The correct recovery technique to recover from the spin is determined during the aircraft handling properties certification process.
 - This technique is assessed for the aircraft type for incorporation in the aircraft flying manual approved by the regulatory body concerned
 - Spin recovery techniques can vary between aircraft types and the recovery method must be understood and demonstrated during the pilots training¹⁵.

¹⁵ CAA NZ 'Good Aviation Practice' booklet 'Spin Avoidance and Recovery' 2014 <u>https://www.aviation.govt.nz/assets/publications/gaps/spin-avoidance-and-recovery.pdf</u>





1.18.4. Safety Management System (SMS)

- (1) An SMS is a systematic approach to managing safety, including the necessary organizational structures, accountability, responsibilities, policies and procedures.
- (2) The objective of an SMS is to provide a structured approach to safety risks control in operations. The organisation's specific structures and processes

related to safety of operations must be taken into account in the effective safety management.

- (3) The SMS development begins with setting the organisational safety policy, safety planning and the implementation of safety management procedures are the next key steps in the processes designed to mitigate and contain risk in operations.
- (4) The ICAO Safety Management Manual (SMM) (Doc 9859) contains detailed guidance on the implementation of an SMS. The framework for an SMS can be found in ICAO Annex 19/Safety Management.
- (5) The HKAC issued a fully-revised SMS Manual in November 2020.

1.19. Useful or Effective Investigation Techniques

Not applicable in this investigation.

2. Safety Analysis

The Safety Analysis provides a detailed discussion of the safety factors identified during the investigation, providing the evidence required to establish the findings, causes, contributing factors and the safety recommendations.

2.1. Introduction

- (1) The flight departed from Shek Kong with the pilot intending to practise stalls and incipient spin recovery. Over the Tolo Harbour area the pilot commenced these exercises with the result that the aircraft entered into a fully developed spin. The pilot managed to recover but at insufficient altitude to avoid impact with terrain.
- (2) The analysis will discuss various factors including procedures, oversight and human factors.

2.2. Flight Operations

2.2.1. Crew Qualifications

The pilot had been issued with a PPL(A) and held a valid medical certificate.

2.2.2. Operational Procedures

2.2.2.1. Accident Flight

- (1) According to the pilot, the flight was normal before the aircraft was stalled at approximately 2 200 ft AMSL and left rudder was applied. The aircraft yawed to the left and the left wing banked to approximately 45 degrees. As a result of the pilot's control inputs, the incipient stage of a spin started.
- (2) The pilot then applied right rudder in an attempt to recover but the aircraft did not stop yawing and continued to rotate to the left. The aircraft then entered into a fully developed spin.
- (3) The pilot kept applying full right rudder, eventually the rotation stopped and the aircraft was recovering from the spin with the nose pitching up.
- (4) Although the pilot's inputs were eventually effective, the altitude at which the spin commenced was insufficient to recover before the aircraft impacted rising terrain on Ma Shi Chau.

- (5) The nose up attitude of the aircraft was observed by a witness before the impact on the hillslope of Ma Shi Chau.
- (6) The pilot stated there were several spin rotations and full opposite rudder was applied for the recovery prior to impact.
- (7) According to the information from the Flight Manual, the aircraft probably completed at least three to four spin rotations before the rotation stopped. Based on the impact location, the aircraft had an altitude loss of about 2 000 ft until the spin stopped with the aircraft starting to pitch up before the impact on Ma Chi Chau. As the spin was entered at about 2 200 ft, the height was enough for the aircraft to recover from the spin but insufficient to climb away to avoid the terrain at Ma Shi Chau.
- (8) Examination of the wreckage, taking into account impact damage to the aircraft fuselage, wings and flight control services indicated that the aircraft was flying in a relatively horizontal attitude and at a low airspeed transitioning to a climb when it impacted the hillslope. The rate of descent would have decreased significantly and coupled with the low forward speed, the impact forces were lessened.
- (9) The throttle was found to be in the idle position with the propeller pitch and mixture controls in the forward position. To transition to a climb, the pilot would have had to increase power by pushing the throttle forward, but this had not occurred before impact.
- (10) Considering the pilot's lack of experience in spinning and recovery, the pilot had effectively commenced a recovery which may have succeeded if the terrain was not in the flight path.

2.2.2.2. HKAC General Flying Orders

- (1) The pilot had signed the 'GFO Annual Review Form' indicating that the orders and instructions issued by HKAC had been reviewed and understood.
- (2) During the accident flight GFO-06 2 a) was not adhered to, which states that "spinning exercises may only be conducted under the supervision of an instructor except for aerobatic pilots who are cleared for solo spinning".
- (3) By not adhering to GFO-06, the pilot was conducting an unauthorised manoeuvre.
- (4) According to GFO-06, the incipient spin was practised at an unsuitable height i.e. below 3 000 ft.

2.2.2.3. Flight Authorisation

- (1) The pilot initially wrote down "Harbour" and then changed it to "Sector" on the FAL for the accident flight. The HKAC authorizing instructor therefore did not know the pilot's intended actions during the flight.
- (2) The instructor signed the authorisation in good faith, as the pilot did not communicate his intentions. If the pilot had done so, there is a high probability the flight would not have been authorised and the pilot counselled.
- (3) It was noted from other entries of the FAL, pilots routinely put "Sector(s)", which mean "controlled zones" or "uncontrolled zones". Filling out "Sector" only gives location of flight rather than its nature. Alternatively, options such as "circuits" or "aerobatic" may otherwise serve as a prompt for members to configure the aircraft according to the limitations applicable to that category of flight as specified in the AFM, and if necessary, obtain the corresponding briefing prior to the intended flight.
- (4) There is no guidance by the HKAC as to what authorising instructors should ascertain from a pilot regarding their intentions.
- (5) If pilots were required to present their flight plans and inform the authorizing FI their intentions for the flight, the process may have helped identify and mitigate the risk of this flight.
- (6) Based on the above considerations, it would be beneficial for HKAC to enhance the effectiveness of its procedures to require the instructor to elicit adequate information from the pilot to assess if a flight authorisation may be given.

2.2.3. Weather

The weather conditions were within the limits for VFR operations and there was no significant weather affecting the operation of aircraft.

2.3. Aircraft

2.3.1. Aircraft Maintenance

- (1) The maintenance records and the engine examination indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.
- (2) The aircraft had no outstanding defects prior to the accident flight.

2.3.2. Mass and Balance

There is no evidence to suggest that the aircraft was not within the allowable weight and balance limits during the flight.

2.3.3. Aircraft Systems

The investigation team found no evidence that the aircraft or its systems contributed to the accident.

2.4. Human Factors

2.4.1. Experience

- (1) As the pilot had only recently obtained a PPL(A) with a total of 78 hours, the pilot's flying experience was still relatively low.
- (2) During training prior to the accident, the pilot had one session of incipient spin training on 12 February 2017, and according to his statement one hands-on experience of spinning on 25 February 2018.
- (3) Pertaining to the accident flight, the pilot stated to the investigation team that the intention was to carry out stalls, incipient spins and steep turns during the flight, utilising knowledge gained on the spin manoeuvres briefed and demonstrated during training.
- (4) Due to the pilot's inexperience, the consequences of conducting the intentional incipient spin were probably not fully realised until the manoeuvre developed into a full spin.

2.4.2. Perception

- (1) The pilot's stated perception was that the spin manoeuvre was not an aerobatic manoeuvre, as "spinning" and "aerobatics" were described separately under HKAC GFO-06.
- (2) Although definitions of incipient spin vary, it is generally accepted that it is part of a spin manoeuvre, being the transitional stage during which the aircraft progresses from a fully developed stall into autorotation.
- (3) If there had been any doubt about the planned manoeuvre, the pilot could have asked an instructor to clarify any questions he may have regarding spinning. A pilot is required to read and be conversant with the contents of the flight manual prior to each flight.

2.4.3. Aeronautical Decision Making (ADM)

Pertaining to pilots, ADM¹⁶ is a systematic approach to risk assessment and stress management. It is recognized that personal attitudes can influence decision-making. The main components are hazard and risk.

2.4.3.1. ADM Hazard and Risk Management

- (1) The goal of pilots in ADM risk management is to proactively identify safetyrelated hazards and mitigate the associated risks. Risk management is an important component of ADM. When a pilot follows good decision-making practices, the inherent risk in a flight is reduced or even eliminated. The ability to make good decisions is based upon direct or indirect experience and education.
- (2) The HKAC GFO-06 (valid at the time of the accident) stated in 2 a) 'Spinning exercises may only be conducted under dual instruction of an instructor except for aerobatic pilots who are cleared for solo spinning'. The pilot signed stating that the GFOs were understood.
- (3) During the investigation, the pilot stated that the intention of the flight was to practise stall and incipient spin manoeuvres. This plan was not communicated to any FI at the HKAC prior to departure and the pilot entered "Sectors" on the FAL.
- (4) The development of good decision making skills can be taught, but sometimes due to lack of knowledge improper decisions are made. The most important decision a pilot will make is to learn and adhere to published rules.¹⁷
- (5) Inexperienced pilots who are enthusiastic about meeting new challenges may find themselves in an unfamiliar situation that may result in undesired consequences.
- (6) The pilot was presented with a challenging situation after the aircraft started a fully developed spin, and was faced with a complex decision making process due to his lack of experience.
- (7) It is probable that if the pilot's intentions had been conveyed to any of the HKAC instructors, the flight would not have been authorised and the pilot counselled.
- (8) The pilot has been cooperative in providing a statement and forthcoming regarding the intention to carry out unauthorised manoeuvres. This is

¹⁶ FAA Pilot's Handbook of Aeronautical Knowledge Chapter 2 Aeronautical Decision Making

¹⁷ FAA AC 60-22 Aeronautical Decision Making

recognised by the investigation team as being both beneficial to the investigation and as learning factors in preventing further occurrences.

2.5. Survivability

2.5.1. Cockpit Area

As a result of the cockpit structure remaining intact during the impact and coupled with being secured by a five-point safety harness, the pilot survived with minor head injuries.

2.5.2. Emergency Locator Transmitter (ELT)

- (1) The HKMRCC received the 406 MHz ELT first transmission at 0658 hrs on 25 June 2018. The duty operator faxed the alert message to ATC at 0702 hrs on 25 June 2018. ATC confirmed the alert was from B-LUK.
- (2) There were no reports of the 121.5 MHz ELT transmission by overflying aircraft after the accident.
- (3) As the pilot stated to the investigation team that he had recycled the ELT from 'ARMED' to 'OFF', and 'ON' again after impact, the ELT was sent to the manufacturer and tested under the auspices of the BEA. Referring to 'OFF' in this context would mean the 'TEST/RESET' position, as the remote control toggle switch in the cockpit contains only the 'ON', 'ARMED' and 'TEST/RESET' positions.
- (4) It was most probable that the ELT must have been switched off, either by pressing the TEST/RESET switch on the instrument panel, or by switching the main ELT switch to OFF.
- (5) The investigation team was not able to ascertain the circumstances of when or how the ELT was switched off or why the first transmission was not received until the next day at 0658 hrs.
- (6) The lack of transmissions from the ELT did not impact the pilot's survival options as the pilot contacted authorities and rescue services by mobile phone, as had several witnesses following the accident.

2.6. Additional Information

2.6.1. Training Records

(1) Discrepancies relating to exercises registered in the HKAC lesson record, SPR and what was entered in the pilot's personal flying log book were apparent. This suggests that more attention could be given to the maintenance of records by instructors and student pilots.

- (2) There appears to be no system or guidance to instructors by the HKAC to ensure that accurate records are kept in a sequential manner, both in the HKAC records and student's personal flying log books.
- (3) It is incumbent on flying training providers to ensure that newcomers to aviation are guided and mentored. Instructors should guide student pilots on what is required to be entered in their personal log books and also should ensure that the actual lesson completed is recorded accurately by both the student and on the training record.
- (4) The present system of recording training records should be reviewed by the HKAC to address any inadequacies.

2.6.2. Safety Management System (SMS)

- (1) The investigation team considers that the systemic safety risks leading up to this accident due to lack of oversight of pilots' activities by the HKAC may have been mitigated through an effective SMS process.
- (2) SMS is not only effective for large organisations. Experience in other aviation jurisdictions involving flying schools and aviation clubs indicate that an effective SMS would allow for the identification of systemic safety issues and possible risks to be captured and operationally mitigated, whether it be a small or large scale operation.
- (3) Details regarding the nature of flight were not provided in the FAL for review by the authorised FI. Had the pilot informed the FI who authorised the flight of the intention to practise stalling and incipient spins, it would have been assessed that the pilot was not authorised to do so. Therefore, the potential risks of the flight were not identified and mitigated in the flight authorisation process.
- (4) The concept of SMS can be applied to thoroughly review their operations, such as developing processes and implementing remedial action necessary to maintain an acceptable level of safety where pilots should be encouraged to be transparent about the conduct of their intended flights. Authorising instructors could also be given guidance as to what they ascertain from pilots they are authorising to fly.
- (5) Since the HKAC operates as a private member's club which is non-public transport, under the current legislation, there is no requirement for them to operate as a flying training organisation which is required to have an SMS implemented.

(6) The investigation team noted that the HKAC has proactively started applying SMS in the course of their operations.

3. Conclusions

From the evidence available, the following findings are made with respect to the occurrence. These findings should not be read as apportion blame or liability to any particular organization or individual.

3.1. Findings

- (1) The pilot had been issued with a PPL(A) and held a valid medical certificate. (2.2.1)
- (2) The flight was normal before the aircraft was stalled at approximately 2 200 ft AMSL and left rudder was applied. The aircraft yawed to the left and the left wing banked to approximately 45 degrees. As a result of the pilot's control inputs, the incipient stage of a spin started. (2.2.2.1 (1))
- (3) The pilot then applied right rudder in an attempt to recover but the aircraft did not stop yawing and continued to rotate to the left. The aircraft then entered into a fully developed spin. (2.2.2.1 (2))
- (4) The pilot kept applying full right rudder, eventually the rotation stopped and the aircraft was recovering from the spin with the nose pitching up. (2.2.2.1 (3))
- (5) Although the pilot's inputs were eventually effective, the altitude at which the spin commenced was insufficient to recover before the aircraft impacted rising terrain on Ma Shi Chau. (2.2.2.1 (4))
- (6) Considering the pilot's lack of experience in spinning and recovery, the pilot had effectively commenced a recovery which may have succeeded if the terrain was not in the flight path. (2.2.2.1 (10))
- (7) The pilot had signed the "GFO Annual Review Form" indicating that the orders and instructions issued by HKAC had been reviewed and understood. (2.2.2.2 (1))
- (8) By not adhering to GFO-06, the pilot was conducting an unauthorised manoeuvre. (2.2.2.2 (3))
- (9) According to the GFO-06, the incipient spin was practised at an unsuitable height i.e. below 3 000 ft.(2.2.2.2 (4))

- (10) The pilot initially wrote down "Harbour" and then changed it to "Sector" on the FAL for the accident flight. The HKAC authorizing instructor therefore did not know the pilot's intended actions during the flight. (2.2.2.3 (1))
- (11) The instructor signed the authorisation in good faith, as the pilot did not communicate his intentions. If the pilot had done so, there is a high probability the flight would not have been authorised and the pilot counselled. (2.2.2.3 (2))
- (12) It would be beneficial for HKAC to enhance the effectiveness of its procedures to require the instructor to elicit adequate information from the pilot to assess if a flight authorisation may be given (2.2.2.3 (6)).
- (13) The weather conditions were within the limits for VFR operations and there was no significant weather affecting the operation of aircraft. (2.2.3)
- (14) The maintenance records and the engine examination indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures. (2.3.1 (1))
- (15) The aircraft had no outstanding defects prior to the accident flight. (2.3.1 (2))
- (16) Pertaining to the accident flight, the pilot stated to the investigation team that the intention was to carry out stalls, incipient spins and steep turns during the flight, utilising knowledge gained on the spin manoeuvres briefed and demonstrated during training. (2.4.1 (3))
- (17) The pilot's stated perception was that the spin manoeuvre was not an aerobatic manoeuvre as "spinning" and "aerobatics" were described separately under HKAC GFO-06. (2.4.2 (1))
- (18) The lack of transmissions from the ELT did not impact the pilot's survival options as the pilot contacted authorities and rescue services by mobile phone, as had several witnesses following the accident. (2.5.2 (6))
- (19) Discrepancies relating to exercises registered in the HKAC lesson record, SPR and what was entered in the pilot's personal flying log book were apparent. (2.6.1 (1))
- (20) There appears to be no system or guidance to instructors by the HKAC to ensure that accurate records are kept in a sequential manner, both in the HKAC records and student's personal flying log books. The present system of recording training records should be reviewed by the HKAC to address any inadequacies. (2.6.1 (2), 2.6.1 (4))

- (21) Details regarding the nature of flight were not provided in the FAL for review by the authorising FI. Had the pilot informed the FI who authorised the flight of the intention to practise stalling and incipient spins it would have been assessed that the pilot was not authorised to do so. Therefore, the potential risks of the flight were not identified and mitigated in the flight authorisation process. (2.6.2 (3))
- (22) The investigation team noted that the HKAC has proactively started applying SMS in the course of their operations. (2.6.2 (6))

3.2. Causes

Whilst conducting aerodynamic stall practice at 2 200 ft, the pilot intentionally initiated an incipient spin below the minimum altitude required by the HKAC for spinning. The manoeuvre developed into a full spin. The pilot regained control of the aircraft at an altitude that limited an effective recovery resulting in the aircraft impacting terrain. [(3.1 (2)) (3.1(3)) 3.1 (4)) 3.1 (5))]

3.3. Contributing Factors

- (1) The pilot was conducting an unauthorised manoeuvre. (3.1 (8))
- (2) Details regarding the nature of flight were not provided in the FAL for review by the authorising FI. The potential risks of the flight were not identified and mitigated in the flight authorisation process. (3.1 (21))

4. Safety Issues Already Implemented

4.1. CAD

The CAD advised that;

- (1) CAD regulates HKAC pilot members engaging in flying activities through the issuance of pilot licences, type ratings, instructor ratings and examiner authorisation in accordance with Cap. 448C, with a view to preventing recurrence and enhancement of flight safety. Soon after the accident, an urgent meeting between CAD and HKAC was held on 26 June 2018. HKAC was recommended, and completed measures to address:
 - i) requirements for aerobatic manoeuvres;
 - ii) type conversion and check out requirements for newly licensed pilots;
 - iii) enhanced training and briefing of "Single Crew CRM".
- (2) In addition, CAD also conducted a holistic review on HKAC's operations and its documents. A completely new set of Operations Manuals and Training Manuals with more detailed and enhanced requirements for HKAC's operations and training have been incorporated in their manuals since July 2021 with changes to the PPL training syllabus, differences training between aircraft types, etc.
- (3) CAD has also reviewed the case and taken appropriate regulatory actions against the pilot licence holder.

4.2. HKAC

The HKAC advised that;

- a. The Fixed Wing Pre-Flight Booking Out Form (Appendix 6D Page A6-25 of the OM) contains a box that requires completion by the PIC labelled: "Nature of Flight (Exercise to be flown)" which the Senior Pilot/AFI/FI will read prior to signing off on the flight.
- b. Section 5.3 Privileges and Limitations of the Private Pilot (HK Private Pilot's License) states "He/she shall not practice any emergency procedures without an instructor on board." In bold writing. The PIC will also initial the box marked "I have read and understood the latest updates in the Operations Manual" on the Booking Out Form.
- c. Section 5.3.4 states Aerobatic Flight including spinning and incipient spin is not permitted at this time with the exception as detailed in 5.5.13.

i. For reference – 5.5.13 Spinning Training - AFI's and FI's (A) are responsible for delivering spin avoidance training to Private Pilots and are therefore the only members of the HKAC that are required to complete full spin training as detailed in Section 2 of the HKAC Aeroplane Training Volume 2 and will follow the same validity periods of the AFI/FI C of T.

a. The HKAC now has a standardised training syllabus which contains an "Instructors comments and recommendations" section after every flight that must include the date and must be counter signed by the student.

b. In addition the wording in section in 2.4 Instructional Methods of the HKAC Aeroplane Training Volume 1 reads:

ii. 2.4.2 Post Flight Debriefing – The student should be debriefed as soon as practicable after each flight. The debriefing must match the subsequent entry in the student's training record, which the student must initial.

iii. 2.4.3 Adherence to Syllabus – Instructors are to give instruction in accordance with the flight training syllabus in this Part and the theoretical knowledge syllabus in Section 3. It is essential that instruction is standardised to avoid confusion if the student should fly with more than one instructor. Any examples of a lack of standardisation are to be brought to the attention of the HOT or CFI.

5. Safety Recommendations

5.1. Safety Recommendation 05-2023

HKAC should enhance the effectiveness of procedures to require the instructor who is authorising a flight to elicit adequate information from the pilot to assess if a flight authorisation may be given. (3.1 (11), 3.1 (12))

Safety Recommendation Owner: Aviation Club of Hong Kong, China¹⁸

5.2. Safety Recommendation 06-2023

HKAC should review the training record system of PPL(A) candidates and continuously monitor the consistency of the records amongst the Pilot's Personal Flying Log Book, PPL Lesson Record and Student's Pilot Record for substantiating the application for a PPL(A) licence. (3.1 (19), 3.1 (20))

Safety Recommendation Owner: Aviation Club of Hong Kong, China

¹⁸ Prior to the completion of this report, the Hong Kong Aviation Club changed their name to Aviation Club of Hong Kong, China

6. General Details

6.1. Occurrence Details

Date and time:	24 June 2018 at 1638 hours	
Occurrence category:	Accident	
Primary occurrence type:	Loss of Control Inflight	
Location:	Ma Shi Chau, New Territories, Hong Kong	
	Latitude: 22º27'07.42" N	Longitude: 114º13'35.978" E

6.2. Pilot Information

6.2.1. Pilot-in-Command

Age:	23 years
Licence:	Hong Kong Private Pilot's Licence (Aeroplanes)
Certificate of Test	C172 type of aircraft with validity from 24 February 2018 to 23 March 2019
Date of first issue of aircraft rating on type:	23 March 2018 (perpetual)
Instrument rating:	N/A
Medical certificate:	Class 2, valid to 31 March 2022
Date of last proficiency check on type:	24 February 2018
Date of last line check on type:	N/A
Date of last emergency drills check:	N/A
ICAO Language Proficiency:	N/A
Limitation:	Corrective lenses are required
Flying Experience:	

Total all types:	78 hours
Total on type (Zlin 242L) :	3.5 hours
Total in last 90 days:	9:25
Total in last 30 days :	4 hours
Total in last 7 days:	50 minutes
Total in last 24 hours:	10 minutes (Accident Flight)

6.3. Aircraft Details

Manufacturer and model:	ZLIN AIRCRAFT a.s. OTROKOVICE Z 242 L	
Registration:	Hong Kong SAR, China / B-LUK	
Aircraft Serial number:	0820	
Year of Manufacture	2017	
Engine	One Lycoming AEIO-	360-A1B6
Engine Serial Number	L-37035-51E	
Operator:	Hong Kong Aviation Club Limited	
Type of Operation:	Aerial Work	
Certificate of Airworthiness	Issued on 14 November 2017 in the Aerial Work Category and valid until 13 November 2018	
Departure:	Shek Kong Airfield	
Destination:	Shek Kong Airfield	
Maximum Take-off Weight	1090 Kg (Normal Category)	
Total Airframe Hours	153.4	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 1	Passengers – 0
Aircraft damage:	Major Damage	

6.4. Aerodrome Information

6.4.1. Aerodrome of Departure and Destination

Aerodrome Code	VHSK
Airport Name	Shek Kong
Airport Address	New Territories, Hong Kong SAR
Airport Authority	PLAAF
Air Navigation Services	N/A
Type of Traffic Permitted	VFR
Coordinates	22° 26' 02" N, 114° 04' 08" E
Elevation	50 ft
Runway Length	1 882 m
Runway Width	36 m
Stopway	N/A
Azimuth	11/29
Category for Rescue and Fire Fighting Services	N/A

7. Abbreviations

AAIA	Air Accident Investigation Authority
ADM	Aeronautical Decision Making
AE	Authorized Examiner
AFI	Assistant Flying Instructor
AFM	Airplane Flight Manual
AGL	Above Ground Level
AIR	Airborne Image Recording
AMSL	Above Mean Sea Level
AMU	Acceleration Monitoring Unit
AOPA	Aircraft Pilots and Owners Association
ATC	Air Traffic Control
ATO	Approved Training Organisation
AVGAS	Aviation Gasoline
BEA	Bureau of Enquiry and Analysis for Civil Aviation Safety France
C152 / 172	Cessna C152 / C172
CAD	Civil Aviation Department
CAD 54	Requirements Document: Pilot Licences and Associated Ratings
Cap. 448B	Hong Kong Civil Aviation (Investigation of Accidents) Regulations
Cap. 448C	Air Navigation (Hong Kong) Order 1995
CFI	Chief Flying Instructor
CVR	Cockpit Voice Recorder
DCA 270	Hong Kong Civil Aviation Department AFI Rating / FI Rating Initial
	Issue / Renewal / Removal of Restrictions Form
DCA	Hong Kong Civil Aviation Department Private Pilot's Licence
528/PPL(A)	(Aeroplanes) Initial Issue / Renewal / Aircraft Rating (DCA
	528/PPL(A))
EASA	European Aviation Safety Agency
EFATO	Engine Failure after Take-Off
ELT	Emergency Locator Transmitter
FAL	Flight Authorisation Log

FDR	Flight Data Recorder
FI	Flying Instructor
FIE	Flying Instructor Examiner
FIR	Flight Information Region
FSD	Fire Services Department
ft	Feet
ft/min	Feet Per Minute
GFO	General Flying Orders - Hong Kong Aviation Club
GFS	Government Flying Service
HASELL	Height, Airframe, Security, Engine, Location & Lookout.
HKAC	Hong Kong Aviation Club Limited. Now known as the Aviation Club
	of Hong Kong, China
HKAC SPR	Hong Kong Aviation Club Student Pilot Record
HKASP	Hong Kong Aviation Safety Program
НК	Hong Kong SAR
HKMRCC	Hong Kong Maritime Rescue Co-ordination Centre
НКО	Hong Kong Observatory
HKPF	Hong Kong Police Force
НОТ	Head of Training HKAC
HP	Horse Power
hPa	Hectopascal
hrs	Hours
IF	Instrument Flying
JAR-FCL	Joint Aviation Requirements Flight Crew License
KDG	Kadoorie Gap
kg	Kilograms
Km	Kilometres
kt	Knots
L	Litres
М	Metres
MBY	Mirs Bay
MHz	Megahertz

NEW	New Town
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board
PED	Personal Electronic Device
PELO	Personnel Licensing Office
PIC	Pilot-in-command
PLAAF	People's Liberation Army Air Force
POOLEY'S	Aircraft Pilots and Owners Association (AOPA) European Joint
	Aviation Requirements Flight Crew License (JAR-FCL) Syllabus &
	Pilot's Record of Training (Private Pilots Licence Course (A))
	published by Pooley's Flight Equipment Ltd on behalf of the AOPA
PPL(A)	Private Pilot's Licence (Aeroplane)
RT	Radiotelephony
SKOI	Shek Kong Operation Instructions
SMS	Safety Management System
SPR	Hong Kong Aviation Club Student Pilot's Record
SR	Safety Recommendation
TMS TAR	Tai Mo Shan Terminal Area Radar
TOL	Tolo
UCARA	Uncontrolled Airspace Reporting Area
VFR	Visual Flight Rules
VHF	Very High Frequency
VHSK	Shek Kong Airfield

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