民航意外調查機構

AAIA

Air Accident Investigation Authority

Loss of Control Inflight

Accident Investigation
Final Report

Zlin-Z-242-L

Hong Kong

February 2016

02-2020

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16 September 2020

The Honourable Mrs Carrie LAM CHENG Yuet-ngor, GBM, GBS
The Chief Executive
Hong Kong Special Administrative Region
People's Republic of China
Chief Executive's Office
Tamar, Hong Kong

Dear Madam,

In accordance with Regulation 10A(1) of the Hong Kong Civil Aviation (Investigation of Accidents) Regulations, I have the honour to submit an investigation report on the accident involving a Zlin Z 242 L aircraft, registration B-LUR operated by Hong Kong Aviation Club at offshore of Fu Tau Sha at Tolo Channel, Tai Po on 27 February 2016.

Yours faithfully,

(LEUNG Man-fat)
Chief Inspector
Air Accident Investigation Authority

Reader Advisory Information

Safety Investigations

The object of a safety investigation is to identify and reduce safety-related risk.

AAIA investigations determine and communicate the factors related to transport safety occurrences under investigation.

It is not a function of the AAIA to apportion blame or determine liability, while at the same time an investigation report must also include the factual material of sufficient weight to support the analysis, findings and safety recommendations.

At all times the AAIA endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

This air accident investigation final report contains information of an occurrence involving a Zlin Z 242 L aircraft, registration B-LUR, operated by the Hong Kong Aviation Club, which occurred on the 27th February 2016.

The information contained in this final report is to inform the aviation industry and the travelling public of the general circumstances of the accident. This factual report supersedes all previous Preliminary and Interim air accident reports concerning this accident investigation.

The Investigator-in-charge (IIC) was assisted by advisors from the aircraft, engine and propeller manufacturers and the aircraft operator.

As accident investigation reports are public documents, this is a reader advisory to assist with the interpretation of the information for the public and to assist with following the sequence and chain of events covered in the factual information of the accident flight.

The chronology and event timeline concerning the history of the flight is linear; to assist with understanding the complex lines of information the descriptive text is supplemented where relevant with images, diagrams and/or maps indicating the flight path and various critical or key information on the accident timeline with a reference to a map position, diagram or component location.

The conduct of this investigation was in accordance with Annex 13 to the Convention on International Civil Aviation and The Hong Kong Civil Aviation (Investigation of Accidents) Regulations (Cap. 448B).

The Air Accident Investigation Authority has compiled this report for the sole purpose of improving aviation safety.

Having established all of the relevant factors, this air accident investigation final report will advise of the safety recommendations intended to prevent a reoccurrence or to reduce the safety risk.

Chief Inspector

Air Accident Investigation Authority

Hong Kong

Synopsis

On 27th February 2016 the pilot of Zlin Z 242 L aircraft, registered B-LUR, departed from Shek Kong Airfield at around 13:45 hrs for a flight to the aerobatic area near Mirs Bay.

The pilot, the only occupant, requested to go to the aerobatic area in Mirs Bay for spin recovery exercises. Spin recovery requiring a minimum cloud ceiling to allow for sufficient recovery height following the entry into the spin.

While airborne, at about 14:08 hrs, the pilot cancelled the request due to the weather in the training area and remained flying over the Tolo Channel in the Tai Po area.

The accident occurred at around 14:10 hrs when the aircraft lost control inflight, descending rapidly prior to impacting the sea offshore of Fu Tau Sha, in the Tolo Channel.

The pilot was fatally injured.

There are four Safety Recommendations (SR) addressed to the Civil Aviation Department (the Regulator) and the Hong Kong Aviation Club (HKAC).

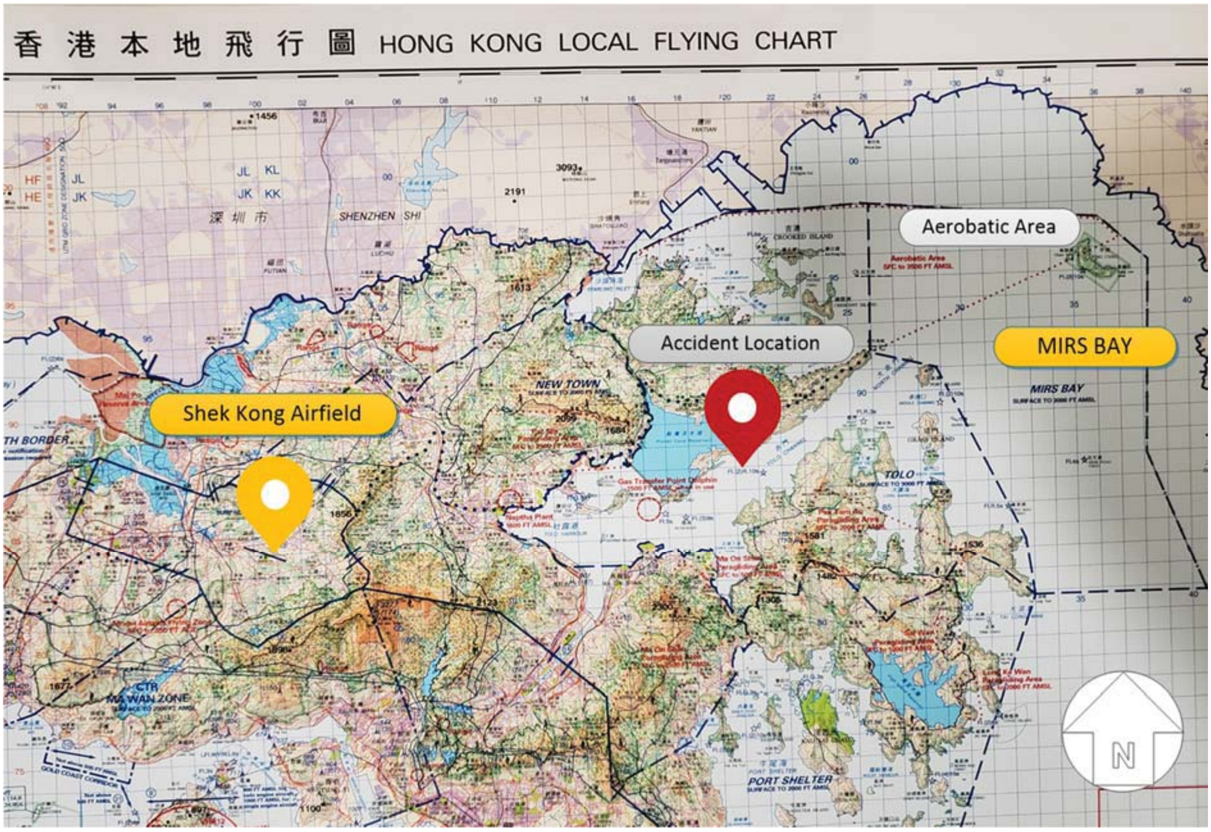

Figure 1: Location of the Accident Site

Contents

1. Factual Information

1.1. History of the Flight

1.1.1. Pre-flight Preparation

The pilot planned the flight with the intention of practising spin recovery exercises in the designated aerobatic area near Mirs Bay.

On the Civil Aviation Department (CAD) VFR Local Flight Notification Form the pilot requested - 4000ft AMSL at MBY for spin recovery exercise (approximately 5 minutes), in the Mirs Bay (MBY) area[1].

The VFR Local Flight Notification Form was sent to the Hong Kong Air Traffic Control (ATC) as permission from ATC is required for operations above 3,000 ft in the area.

The pilot had also signed the aircraft Flight Authorisation Log (FAL), a requirement prior to take-off indicating compliance with the General Flying Orders (GFO) including GFO-02 and GFO-06.

1.1.2. Departure and Transition Flight to the Aerobatic Area

At 13:45 hrs the aircraft departed from Shek Kong Airfield with the pilot as the only occupant.

The aircraft was operating on a Visual Flight Rules (VFR) flight for MBY via TOLO in an Uncontrolled Airspace Reporting Area (UCARAs) in Class G airspace.

The flight was not under active radar control by the ATC, UCARAs are sectors where the ATC provides a flight information service.

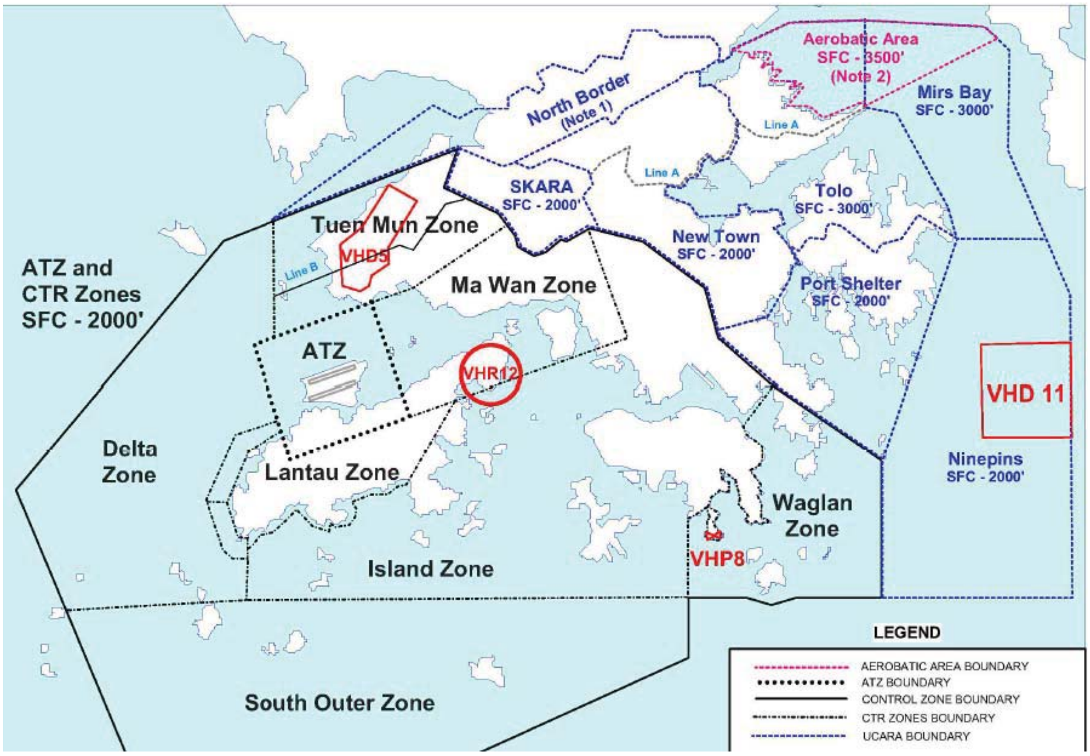

Figure 2 - Uncontrolled Airspace Reporting Areas (UCARAs)

[1] The northern portion of MBY and the north-eastern portion of TOLO is an area that may be used for aerobatic flying.

At 13:50:43 hrs, ATC advised the pilot of the current QNH[2] of 1024 hPa.

According to the radar data from the Tai Mo Shan Secondary Surveillance Radar (TMS SSR), the aircraft was on an easterly track over NEW TOWN at around 13:51 hrs.

At 13:58:35 hrs, the aircraft was flying over Tolo Channel.

ATC called the pilot to confirm if he would ‘request 4,000 ft initially’. The pilot replied “Affirm, to request to enter at MIRS BAY”.

At 14:08:37 hrs, the pilot called and advised ATC that “due to weather, Uniform Romeo will stay in TOLO below 3,000 ft”.

At 14:09:32 hrs, the aircraft was at 2,900 ft as recorded at the TMS SSR.

At 14:09:37 hrs, the aircraft began descending rapidly.

At 14:09:57 hrs, the aircraft transponder was not detected by radar; the final transponder altitude interrogation indicated the aircraft was at 300 ft south of Plover Cove Reservoir in TOLO.

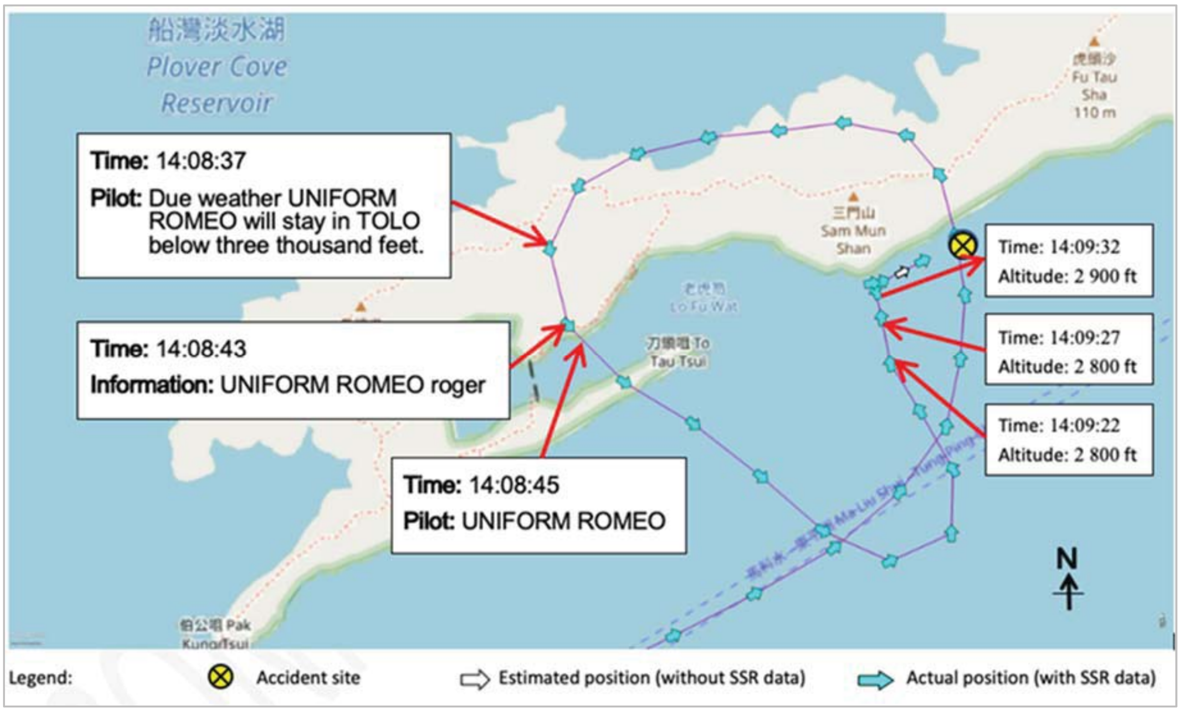

Figure 3 - Radar data with RTF transcript and headings prior to reaching 2,900 ft AMSL

[2] atmospheric pressure adjusted to mean sea level

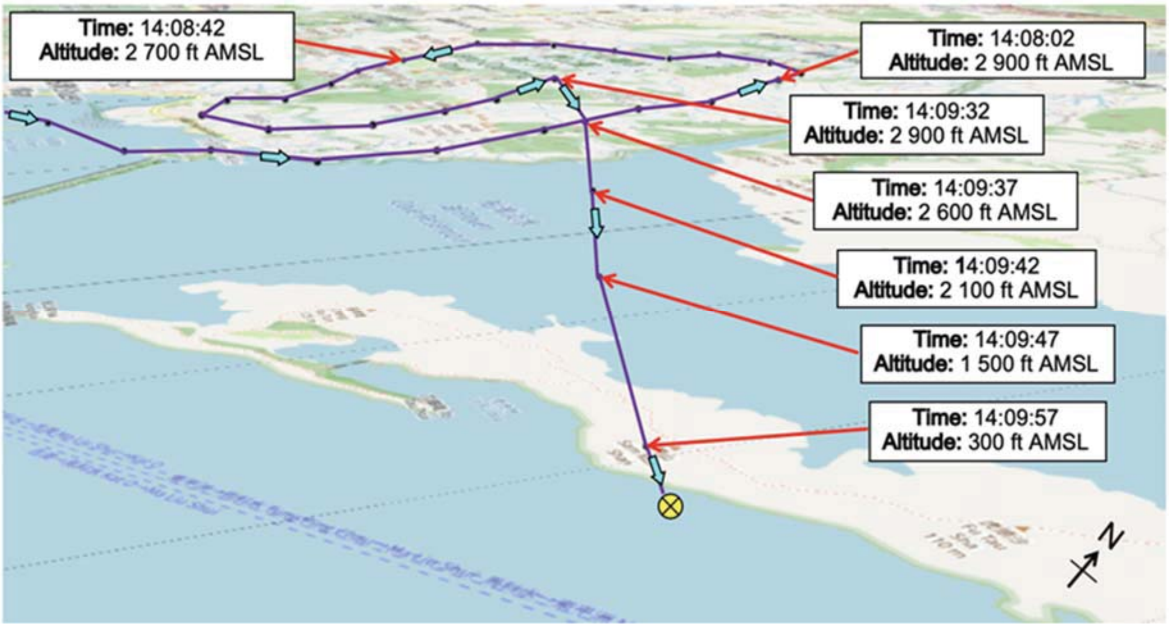

Figure 4 - Isometric view of the SSR data

1.1.3. Accident Location and Emergency Response

The local emergency services received a number of calls from 14:10 hrs onwards, reporting of a small aircraft that had crashed offshore of Fu Tau Sha at Tolo Channel.

FIS and other aircraft in the vicinity attempted to contact B-LUR on the VHF frequency with no response.

Between 14:20 and 14:27 hrs, the Fire Services Communications Centre (FSCC) received reports from the public regarding an aircraft crash offshore of Fu Tau Sha at Tolo Channel.

Figure 5 - Accident Location

1.1.4. Witness Information

There were several observers of the accident.

Witness Group 1

A group of witnesses reported that they noticed the aircraft when it was at about 200 to 250 m above the water, and it "was facing nose-down diving vertically with some 'shaking' oscillations along the aircraft's longitudinal axis while slowly spinning at the same time in clockwise direction". No smoke from the aircraft was observed. They did not see the impact from their position. They described the weather as generally good, a bit hazy but not windy.

Witness Group 2

A witness aboard a boat about 400 to 500 m from the impact point, was able to direct the Marine Police to the approximate location of the accident site.

Having initially noticed the aircraft when it was about four to five storeys above the sea, he described the aircraft was rotating slowly clockwise viewed from above and having a quite vertical nose-down attitude before impacting with the water. There was no smoke or explosion. The witness described the weather as sunny and calm.

Neither party heard the sound of the engine.

1.2. Injuries to Persons

The pilot was the only occupant of the aircraft. The pilot was fatally injured.

<table>
<tr><th colspan="7">Injuries to Persons</th></tr>
<tr><td>Persons on board:</td><td>Crew</td><td>1</td><td>Passengers</td><td>0</td><td rowspan="2">Others</td><td rowspan="2">0</td></tr>
<tr><td>Injuries</td><td>Crew</td><td>1</td><td>Passengers</td><td>0</td></tr>
</table>

Table 1 - Injuries to Persons

1.3. Damage - Aircraft

1.3.1. Damage

Figure 6 - Aircraft as Recovered

All control surfaces and assemblies were accounted for with all damage to the aircraft due to the impact with the sea.

1.4. Other Damages

There was no consequential damage – the aircraft impacted the sea.

1.5. Personnel Information

1.5.1. Pilot Information

Licence

The pilot held a valid Private Pilot's Licence (Aeroplanes), endorsed for Group A – All single-engine aeroplanes (landplanes) of which the maximum total weight authorised does not exceed 5,700 kg[3].

Medical

The pilot held a valid Class 2 medical, with the provision for the carriage of additional corrective lenses.

1.5.2. Pilot's Training - Incipient spin training on Zlin Z 242 L

Pilot Training Background (Spin Training)

HKAC advised that the pilot had started his aerobatic course in 2013.

The pilot conducted nine flights including incipient spins on the Zlin Z 242 L, six of which were instructional between 3 August 2013 and 3 January 2015.

Referenced in the pilot's Flying Instruction Record that four flights conducted between 17 February and 7 July 2013 were 'Type Convex' (i.e. type conversion), there was no documentary evidence that an aerobatic course syllabus on Zlin Z 242 L established in 2013 while the pilot was taking his type conversion training.

The type conversion flight on 22 June 2013 lasted for 0.5 hrs, the pilot had received training and been assessed on incipient spin according to his Flying Instructions Record.

As per the incipient spin recovery as defined and provided by the HKAC, the pilot would have demonstrated competence on the flight to neutralise controls (ailerons, elevator and rudder) and recover the aircraft back to straight and level before the aircraft entered into a full spin.

Incipient spin and recovery manoeuvres are not defined in the Zlin Z 242 L AFM.

The Zlin manual specifies recovery techniques for unintentional and normal spin, both of which require 'full deflection against the direction of rotation' of the rudder, prior to elevator inputs'.

[3] Refer to Section 6. General Details

1.5.3. Spin Training and Assessment on Zlin Z 242 L

Flying Instruction Record

Date	Exercise	Dual	Remarks
17 Feb 2013	Z 242 L Type Convex	1.1	Steep turns, slow flight, stalls without & with flaps
24 Feb 2013	Z 242 L Type Convex	0.9	Cleared for PPL flying
22 Jun 2013	Z 242 L Type Convex	0.5	Incipient spin and go around with full flap, satisfactory
07 July 2013	Z 242 L Type Convex	0.9	Full spin recovery/Demonstrated to satisfaction

Table 2 - Flying Instruction Record

The pilot started his aerobatic course on B-LUR on 22 June 2013.

The pilot was checked for 'full spin recovery' to satisfaction on 7 July 2013 on Zlin Z 242 L.

1.6. Aircraft Information

1.6.1. Aircraft Information

Zlin Z 242 L General Information

The aircraft was a single-engine, all-metal low-winged cantilever monoplane with a low-mounted tail plane, and fixed tricycle landing gear with steerable nose wheel.

Two abreast seats were provided with dual controls.

The flight load factor limits operated under aerobatic category are certified between +6 and -3.5 g.

Manufacturer and model:	Zlin Z 242 L
Registration:	B-LUR
Engine	Lycoming AEIO-360-A1B6
Propeller	MTV-9-B-C/C
Operator:	Hong Kong Aviation Club
Serial number:	0791

Table 3 - Aircraft Information

Type Certificate

B-LUR held a Type Certificate issued by the European Aviation Safety Agency (EASA), in accordance with the EASA Certification Specifications (CS).

A Type Certificate for the Zlin Z 242 L aircraft was issued in accordance with Hong Kong certification procedures on the basis of the certification made by EASA.

Engine

The aircraft is powered by a Lycoming AEIO-360-A1B6 engine with a MTV-9-B-C/C-188-18a propeller. The reciprocating four-stroke four-cylinder engine is air-cooled, provided with low-pressure fuel injection into a manifold and produced a maximum power of 200 HP.

Propeller

The propeller is a three-blade, hydraulic operated constant speed propeller. The blades are made of wood with composite skin and the surface is coated with acrylic varnish.

Airworthiness and maintenance

Records indicated that the aircraft had been maintained in accordance with Aircraft Maintenance Schedule (AMS) MS Zlin/LUR/01, Issue 1 Revision 0. The most recent scheduled maintenance check of the aircraft, including annual aircraft and engine inspection, had been carried out on 5 February 2016 and the Certificate of Airworthiness was renewed on 23 February 2016. The aircraft had accumulated a total of airframe 714 flight hrs and 711 engine hrs at the time of the accident.

Prior to the accident flight, the aircraft records indicated no outstanding defects.

Date:	Inspection	Airframe (hrs)
06-01-2016	Overhaul Very High Frequency (VHF) radio installed in #2 position after failure of volume control	693
05-02-2016	Annual Inspection – Airframe and Engines	705
06-02-2016	Annual radio and pitot-static inspection	705

Table 4 - Maintenance Records

Flight Controls

Flight controls are conventional, with dual cockpit controls.

Control systems include the elevator and aileron control, rudder control, nose wheel control, wing flaps control and trim tabs control.

The hand control is of stick-type; the rudder control is of pedal-type with main wheel brakes pedals. The elevator and ailerons are rod-controlled; rudder is rod and cable-controlled. The nose wheel control is coupled with the rudder control.

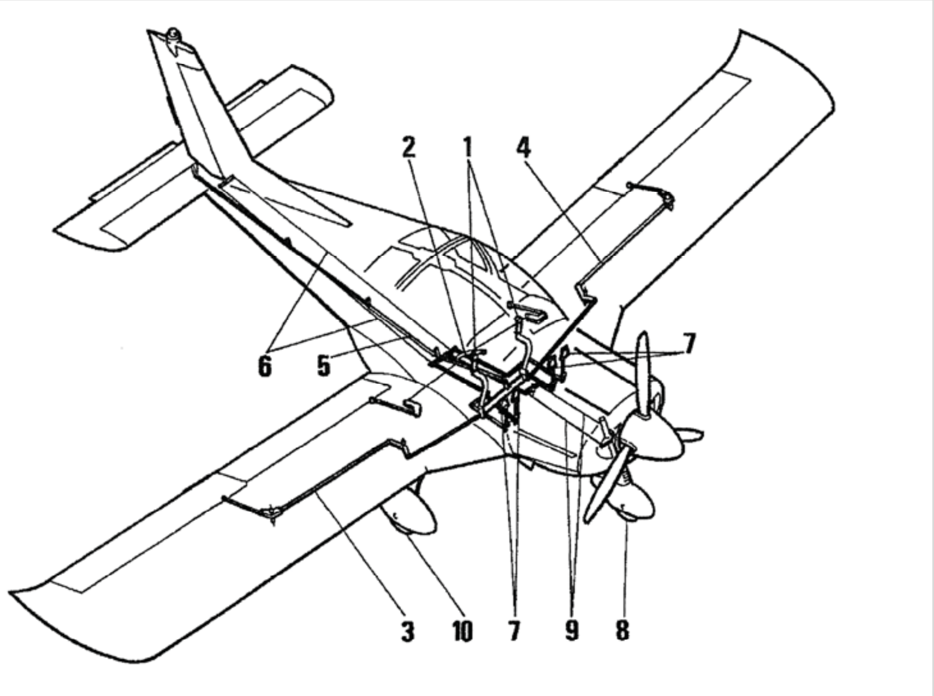

Figure 7 - Flight Controls

Wing Flaps Control Assembly

The wing flaps extension is a mechanical system operated by the pilot through the flap control lever.

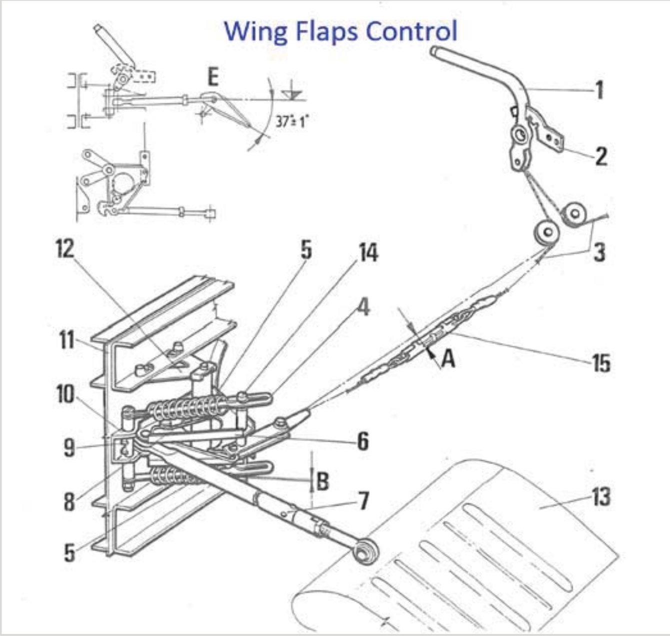

Figure 8 - Wing Flap Control

Acceleration Monitoring Unit (AMU)

The aircraft is equipped with a Speel Praha AMU, installed by the aircraft manufacturer during aircraft production. This unit is fixed on a bracket on the upper flange of the wing main spar in the space under the right hand pilot seat.

Powered by the aircraft battery, initialisation of the unit will start automatically when the aircraft is powered up. Operation of the unit is indicated by a light emitting diode on the central panel located between pilot seats.

The unit is capable of measuring and recording the vertical acceleration data during flight, the flight duration (between lift off and touch down) and the number of take-offs and landings.

1.7. Meteorological Factors

1.7.1. Weather Information

Weather information received from the Hong Kong Observatory (HKO) indicated that at the time of the accident, the automatic weather station at Tai Po Kau recorded light winds.

The 10-minute mean wind speed was approximately five knots (kt) while the maximum gust was around six kt, the wind direction was from the east.

The weather over the Tolo Harbour at that time was good with visibility of over 10 km.

Independent Observations

A pilot flying on a separate flight in the same vicinity as B-LUR between 12:20 and 12:55 hrs (prior to the accident flight) described the sky ‘as a bit hazy with visibility of 5 to 7 km over the Plover Cove Reservoir’.

There was no information regarding the cloud base or report of turbulence from other pilots in the vicinity.

1.8. Navigation Aids

1.8.1. Visual Flight Rules (VFR)

The accident flight was operated in daylight under VFR, during which the aircraft was required to remain clear of cloud and in sight of the surface.

Visual contact with the surface is the principal method of navigation during VFR flight conditions.

1.9. Communications

1.9.1. VHF Radio

The pilot maintained two-way radiotelephony (RTF) communication with ATC on the designated VHF frequency of 121.0 MHz.

The last RTF communication by the pilot was to the ATC, recorded at 14:08:45 hrs.

No distress call was made.

1.10. Aerodrome Information

1.10.1. Remote Accident Site

No relevant information regarding the aerodrome as the accident occurred at sea.

1.11. Flight Recorders

1.11.1. On-board Data Recording Systems

The aircraft was not equipped with a flight data recorder (FDR), a cockpit voice recorder (CVR) or an airborne image recorder (AIR).

There is no regulatory requirement for the installation of data recorders.

Flight track reconstruction was derived from the area radar.

The current regulations do not stipulate that this category of aircraft shall be equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR).

In addition, this category of aircraft is not required to have an Airborne Image Recording (AIR) device installed, which can capture the general cockpit environment, non-verbal flight crew communications, flight crew workload and activity and the status of instrumentation.

1.12. Wreckage and Impact

1.12.1. Location

The wreckage was located on the day of the accident; several areas of debris were recovered from the local area on the sea surface.

The submerged wreckage was located at approximately 16 m depth, easily accessible by divers who conducted an initial underwater survey on 28 February 2016.

The aircraft sustained significant structural deformation consistent with a high-speed water impact.

All of the aircraft wreckage was later recovered.

1.12.2. Evidential Damage

During the investigation, the aircraft was disassembled systematically to determine residual structural evidence on the flight control assemblies and cockpit instrumentation, in particular for witness marks and physical markers characteristic of metallic structural deformation during high impact accidents.

Flap Control/Position Lever

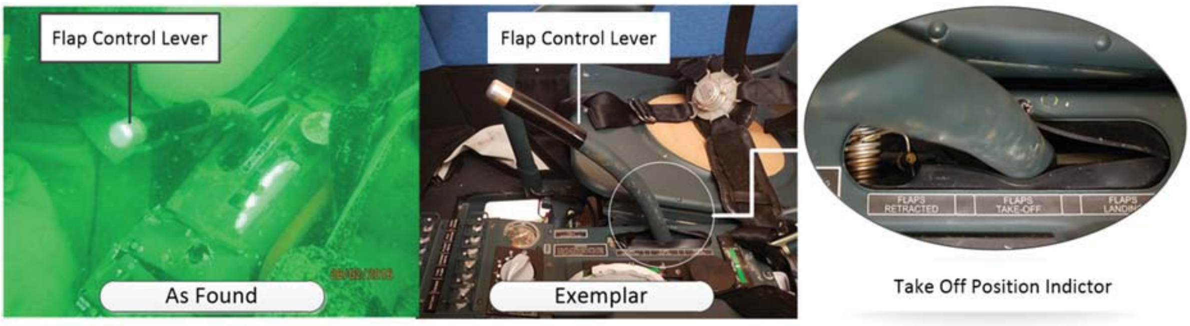

Figure 9 – (Left) Flaps control lever as found underwater. (Right) exemplar for reference

The photo taken prior to the wreckage recovery shows that the flaps control lever is not in the retracted position.

The position of the flap handle as found was between “Flap Retracted” and “Flaps Take-Off” when the wreckage was discovered under the water.

There is a witness mark on the flap pedestal at the ’Flap Retracted’ retracted position.

Flight Controls Continuity Inspection

Inspection on the flight control mechanisms, including the cable runs and linkages of flaps, ailerons, elevator, and rudder was conducted.

The linkages under the control columns connecting to the ailerons were severely damaged at multiple locations.

The control cable continuity was established between the flaps handle lever and the flap control mechanisms inside the wings, even though the flap control cams were displaced.

The elevator control mechanism continuity was established although the control rod connected to the elevator was bent at the point the tail section buckled.

The rudder cables and the attachment points were not damaged.

However, as the rudder (foot) pedals located at the front section of the aircraft were detached from the fuselage and damaged, the continuity of the rod linkages connecting to the rudder cables could not be determined.

Figure 10 – Countershaft Damage

This deformation was found at about the middle of the forward side of the countershaft that connects laterally to both control sticks.

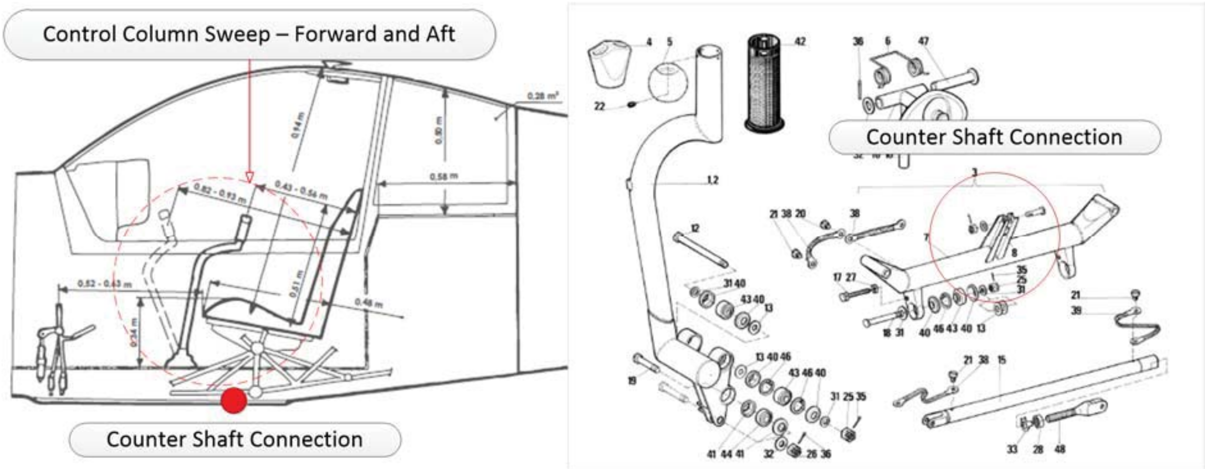

Figure 11 - Control Column Sweep and Counter Shaft Connection Location

Flaps

Both flaps were severely damaged during the impact with the sea.

Right Flap

The outer flap link of the right flap was deformed upward and backward unseating from the lower bolt while still attached to the flap.

There are no witness marks showing that the flap link has been hit from forward or below.

Left Flap

The trailing edge of the left wing was lodged into the outer hinge cover of the flap.

Figure 12 – LH Flap and Hinge Cover/RH Flap Linkage

Elevator

Witness marks were found on the top of the left, centre and right elevator support hinge brackets (Yellow outline).

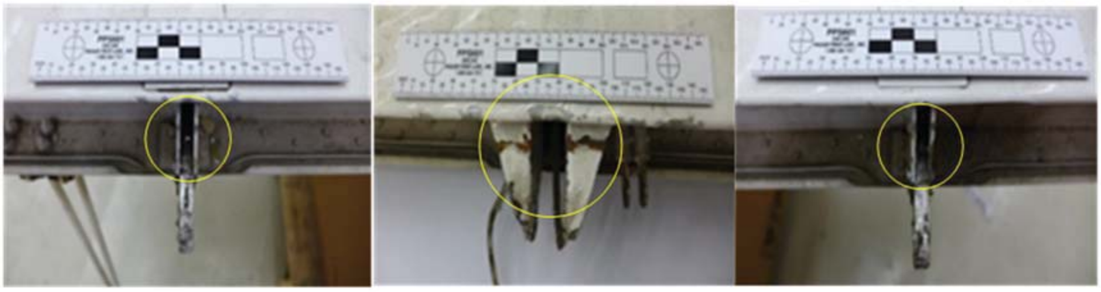

Figure 13 - Witness marks on the top of all elevator support hinge brackets

Vertical Stabiliser/Rudder

The vertical stabilizer and the rudder deformation is consistent with a high speed water impact.

Figure 14 - Rudder and Vertical Stabiliser Deformation

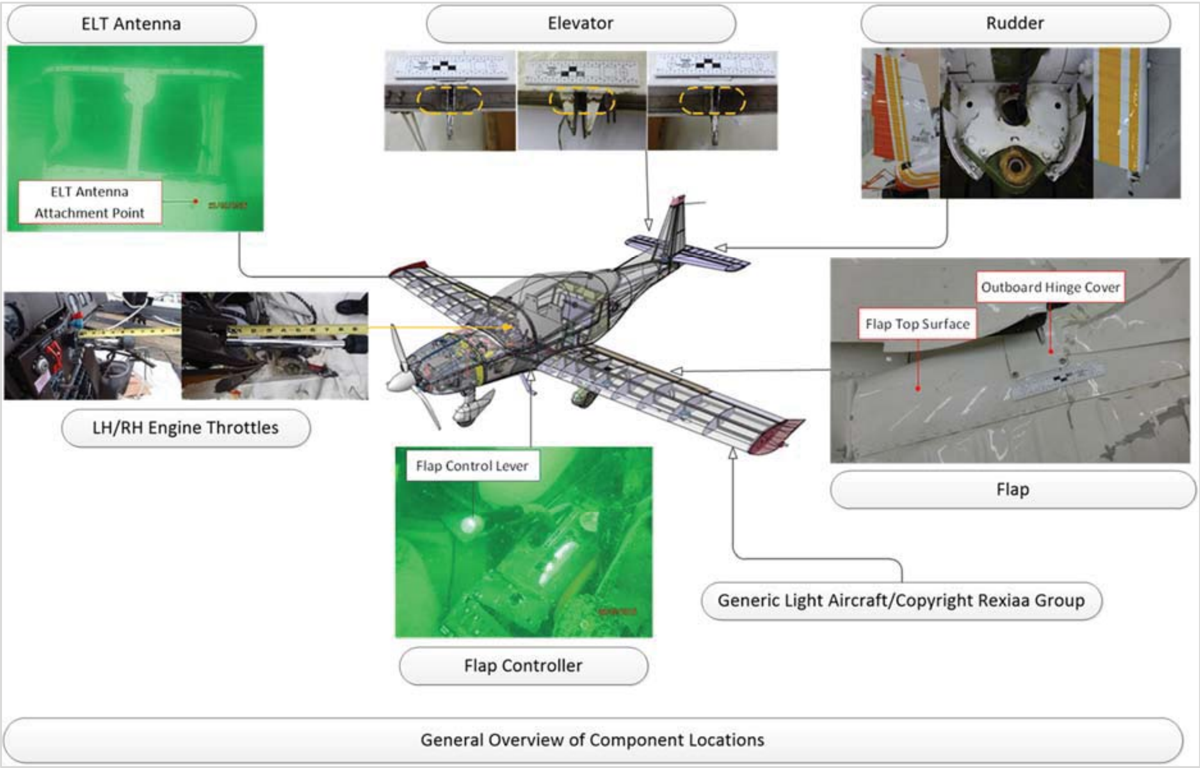

Figure 15 - Overview of Component Locations

Cockpit Instruments

The instrument panel was recovered, the instruments were damaged in the impact and subsequent salt water immersion.

The instrument settings and indicator locations as recovered were recorded.

Accelerometer and Altimeter(s)

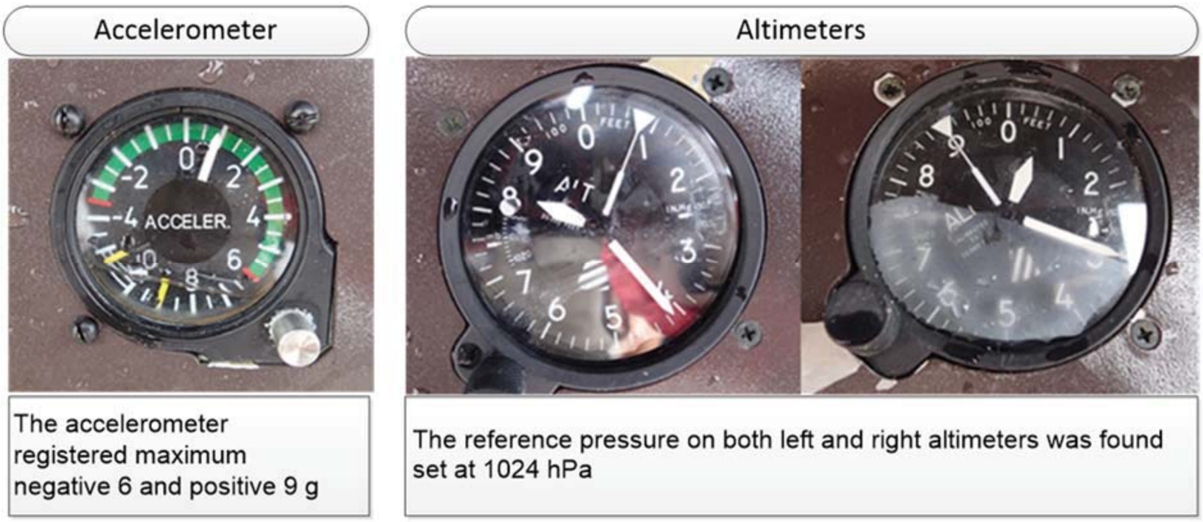

Figure 16 - Instruments

Throttle Levers

Figure 17 - Throttle Position

The instrument panel was deformed during the accident sequence, including around the engine throttle areas.

The left and right engine throttle levers as measured following recovery extended 20.3 cm/8 inchs and 12.7 cm/5 inches (respectively) from the face area of the instrument panel.

1.13. Medical/Pathological Information

1.13.1. Civil Aviation Department (CAD) Medical

The pilot held a valid Class 2 Medical Certificate issued by CAD in accordance with Annex 1 to the Convention on International Civil Aviation, with a limitation – 'Corrective lenses to be worn and additional spectacles to be available.

1.13.2. Pathology (Hong Kong)

An autopsy conducted by a forensic pathologist of the Hong Kong Department of Health indicated that the direct cause of death of the pilot appeared to be multiple injuries.

It showed presence of, among other things, an injury that would have occurred when the pilot was holding the controlling stick of the light aircraft at the time of the crash or that may have occurred. It also showed presence of coronary artery disease with 70% narrowing of a major artery supplying the heart muscles.

1.13.3. Pathology (UK Royal Air Force Centre of Aviation Medicine)

The investigation also sought expert opinion on the autopsy report from the Royal Air Force Centre of Aviation Medical (RAF CAM).

The RAF CAM report states the following regarding the type and location of specific injuries,

1. 'a bruise and fracture of his left thumb and a laceration to the first web space of his right hand. These patterns of hand injuries may be considered as control type injuries and could indicate that the pilot had been controlling (hands on the control column) at the time of the crash. However, control type injuries are very non-specific and although they can give a good indication of the possibility of the controlling of the aircraft at the time of the impact they are not conclusively confirmatory.'
2. that the level of coronary artery disease may have caused a medical condition in flight which distracted the pilot.

1.14. Fire

1.14.1. Fire

There are no indications of an on-board fire or post-accident fire.

1.15. Survival Aspects

1.15.1. Seat restraints / harnesses

The rescue divers confirmed the pilot was restrained by a five-point harness which was found intact.

The five attachment points of the harness were attached to the aircraft structure with no damage.

The harness on the right seat was also found fastened.

1.15.2. Search and Rescue

Upon receiving reports of a small aircraft crash from the public, the FSCC notified ATC which immediately activated its emergency alerting procedures.

Around 15:45 hrs, the submerged aircraft wreckage was located by FSD divers and the pilot was recovered from the left seat inside the cockpit of the aircraft.

A pair of his spectacles was also recovered.

1.15.3. Emergency Locator Transmitter (ELT)

ELTs are emergency transmitters that are carried aboard general aviation aircraft - In the event of an aircraft accident, these devices are designed to transmit a distress signal.

A suitably configured ELT is an integral component of the international satellite system for search and rescue (SAR) COSPAS-SARSAT.

When activated manually or as a result of high 'g' forces on impact - ELTs transmit a distress signal which can be detected by non-geostationary satellites and then located precisely by either or both of GPS trilateration and doppler triangulation provided the signal can be detected.

According to Annex 6 to the Convention on International Civil Aviation, the judicious choice of numbers of ELTs, their type and placement on aircraft, and associated floatable life support systems will ensure the greatest chance of ELT activation in the event of an aircraft operating over water or land, including areas especially difficult for search and rescue.

Accident damage and/or removal of the antenna during an accident impact will reduce the probability of the signal detection.

ELT Location and Arming Switch

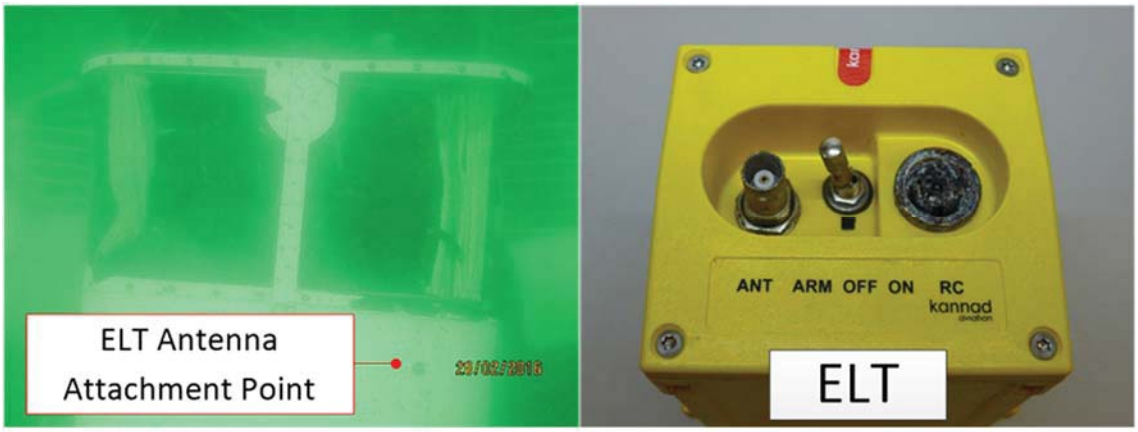

Figure 18 - ELT Location and ARM Switch

The photo on the left taken prior to the wreckage recovery shows that the antenna of the ELT has detached from the upper fuselage.

The ELT was recovered with the toggle switch at the 'ARM' position.

Following the impact with the sea no ELT signal was received.

1.16. Tests and Research

1.16.1. Engine, Propeller and Fuel Verification

To exclude mechanical failure, a propulsion system malfunction or possible fuel contamination, the engine, propeller and a fuel sample were sent for independent verification.

Engine

The engine was shipped to the engine manufacturer in the USA for a full teardown investigation under the supervision of National Transportation Safety Board (NTSB) as Accredited Representative.

The engine fuel system, magneto, oil system, pistons, engine drive system were dissembled and inspected for abnormalities.

Other than corrosion resulting from salt water immersion, no evidence was found that would preclude the engine from developing power prior to the impact.

Propeller

The propeller assembly was removed from the engine and shipped to the propeller manufacturer in Germany for analysis.

The propeller assembly was dismantled for investigation under the supervision of the German Federal Bureau of Aircraft Accident Investigation (BFU) as Accredited Representative at the manufacturer's facilities.

A full teardown inspection of the propeller did not show any indication of malfunction. Based on a post-accident corrosive mark, the blade pitch position was calculated to be at 10 degrees, a 'LOW PITCH' position.

1.17. Organisational and Management Information

1.17.1. Civil Aviation Department (CAD)

CAD oversights the HKAC as a flying club based on the Air Navigation (Hong Kong) Order 1995 (Cap. 448C).

CAD conducted regular audits and inspections on the flight operations and aircraft maintenance standards of the HKAC.

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 is one of the safety indicators under the HKASP.

1.17.2. Hong Kong Aviation Club (HKAC)

The HKAC is a private members club operating from Shek Kong Airfield.

As a private members club, under the current legislation, the HKAC is not required to hold a flying training organisation approval issued by CAD for its operations.

Operations

The HKAC conducts flying training courses for Private Pilot's Licence and Assistant Flight Instructor's (AFI) rating.

Its operations staff under the direction of the General Committee manage the day-to-day operations.

It is an HKAC's requirement on the aircraft Flight Authorisation Log (FAL) that prior to each flight all pilots certify that their aircrew licences are valid and that they have read and understood all relevant flying notices, orders, and NOTAMs.

Local aviation weather forecast and reports (METAR/SPECI) issued by HKO are reviewed by pilots during flight preparation.

Engineering

The HKAC's Engineering Department has licensed aircraft engineers and technicians to maintain the aircraft of the HKAC and its members.

Safety Management System (SMS)

The HKAC was not legally required (as per Cap. 448C) to implement a Safety Management System, however the HKAC was encouraged by the CAD to develop a risk-based Safety Management System (SMS).

The HKAC implemented an SMS voluntarily.

1.17.3. General Flying Orders (GFOs)

HKAC's GFOs are internal documents and are intended as general guidelines similar to general school rules of a flying school.

The CAD has no legal jurisdiction on the requirements of the GFOs.

The HKAC publishes GFOs which are mandatory for all pilots operating fixed-wing aircraft owned by the HKAC.

The GFOs also apply to pilots operating privately owned fixed-wing aircraft based at the HKAC.

The GFOs may only be issued, amended or cancelled by the Chief Flying Instructor (Aeroplanes).

The HKAC requires pilots to read, understand and sign the GFOs every 12 months and whenever a new GFO is published.

New GFOs would be placed on the notice board in the Shek Kong Operations Room for a month, after which they would be inserted into the Flying Order Book (FOB).

Current GFOs are contained in the FOB and are downloaded from the HKAC website by members.

GFO-02 'Pilot Operating Hand-book' requires that 'all pilots must operate the aircraft according to the instructions contained in the Pilot Operating Handbook (POH); where HKAC procedures differ from the POH the pilot must be familiar with these differences and operate the aircraft in accordance with the POH'.

1.17.4. General Flying Order GFO-02: Pilot Operating Handbook (POH)

During the conversion training flight on 22 June 2013 the pilot was assessed as satisfactory for recovering from incipient spin by his instructor.

This procedure is not stated in the AFM and is also a difference as mentioned in GFO-02, HKAC pilots are required to familiarise themselves with any differences.

1.17.5. Aerobatic Course Syllabus for the Zlin Z 242 L

The syllabus of the aerobatic course for the Zlin Z 242 L was not available although the HKAC provided the CAD with a draft PowerPoint document of their aerobatic syllabus.

There was no legal requirement for the CAD to approve or accept the syllabus of the aerobatic course.

HKAC provided the Aircraft Owners and Pilots Association (AOPA) aerobatic syllabus to the CAD, during December 2014, indicating that this was the syllabus they would follow.

The CAD noted the use of the AOPA aerobatic syllabus by the HKAC.

During 2017 the HKAC advised the investigation that the syllabus of the aerobatic course for the Zlin Z 242 L was devised according to the following reference documents:

- Flight Instructor's Manual;
- Air Pilot's Manual – Flying Training Pooley's (April 2016 Edition);
- Aircraft Owners and Pilots Association (AOPA) Guide and Syllabus of Instructor – the Aerobatic Certificate Course (Revised Edition April 1998);
- A PowerPoint briefing entitled "Aerobatics";
- Zlin PDF guide; and
- Copies of the minutes of the HKAC Instructor's Meetings held between 2 May 2013 and 24 October 2016.

The investigation documented the following:

- the document entitled 'Aerobatics' did not cover specific entry or recovery techniques on individual aerobatic manoeuvres, e.g. spinning.
- the Zlin PDF guide used was dated 15 April 2003.- Airplane Flight Manual (AFM) (Rev No. 10 dated 15 April 2003).

1.17.6. Regulatory Oversight - Spin Manoeuvers for the FI rating test

A review of documentation, records and various correspondence between the regulator and the HKAC was conducted to assess the consistency on the FI rating requirements in accordance with Cap. 448C:

- Correspondences between HKAC and regulator on the draft aerobatic syllabus
- HKAC provided the regulator with a draft document of their aerobatic syllabus in early 2015, the draft document did not include incipient spin or full spin recovery.
- The reply from regulator advised HKAC that the aerobatic syllabus should follow the AOPA aerobatic syllabus that included full spin recovery.

. FI rating renewal test on B-LUR dated 17 October 2015

- On the DCA 270 (Dec 2001) form for the FI rating renewal and the removal of the 'Aerobatic Flying (except spinning)' restriction, no test result was made on the Flight Test item E12.2 – Engine failure after take-off. The FI rating renewal test was approved.

Correspondence - March 2016 - from CAD to HKAC on GFO-06

The CAD has provided guidance to the HKAC on its operations.

In this regard requesting HKAC to define the 'minimum altitude for recovery from stall'; the rationale of no specified minimum commencing height for 'instructor training sorties' on spinning, and no specified figures on spinning in Cessna aircraft with regard to GFO-06 (dated 1 April 2014).

1.17.7. Safety Management System (SMS)

An SMS is a systematic approach to managing safety, including the necessary organizational structures, accountability, responsibilities, policies and procedures.

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.

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.

An effective SMS should include the following in content and structure:

a) A process identifying actual and potential safety hazards and assessing the associated risks;

b) A process developing and implementing remedial action necessary to maintain an acceptable level of safety; and

c) Provisions for continuous monitoring and regular assessment of the appropriateness and effectiveness of safety management activities.

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.

Figure 19 - ICAO Annex 19/Safety Management

1.18. Additional Information

1.18.1. Aerobatics – Aircraft Spins

A spin is a special category of stall[4] 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.

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.

[4] A stall is a condition in aerodynamics and aviation such that if the angle of attack increases beyond a certain point then lift begins to decrease.

Either situation causes the aircraft to auto rotate toward the stalled wing due to its higher drag and loss of lift.

Spins are characterized by high angle of attack, an airspeed below the stall on at least one wing and a shallow descent.

Recovery may require a specific and counter-intuitive set of actions by the pilot.

1.18.2. Aircraft Spin - Stages and Recovery[5]

Incipient Stage

- 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.

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 feet 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.

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.

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 training.

[5] Spin Avoidance and Recovery, Civil Aviation Authority of New Zealand (June 2014)

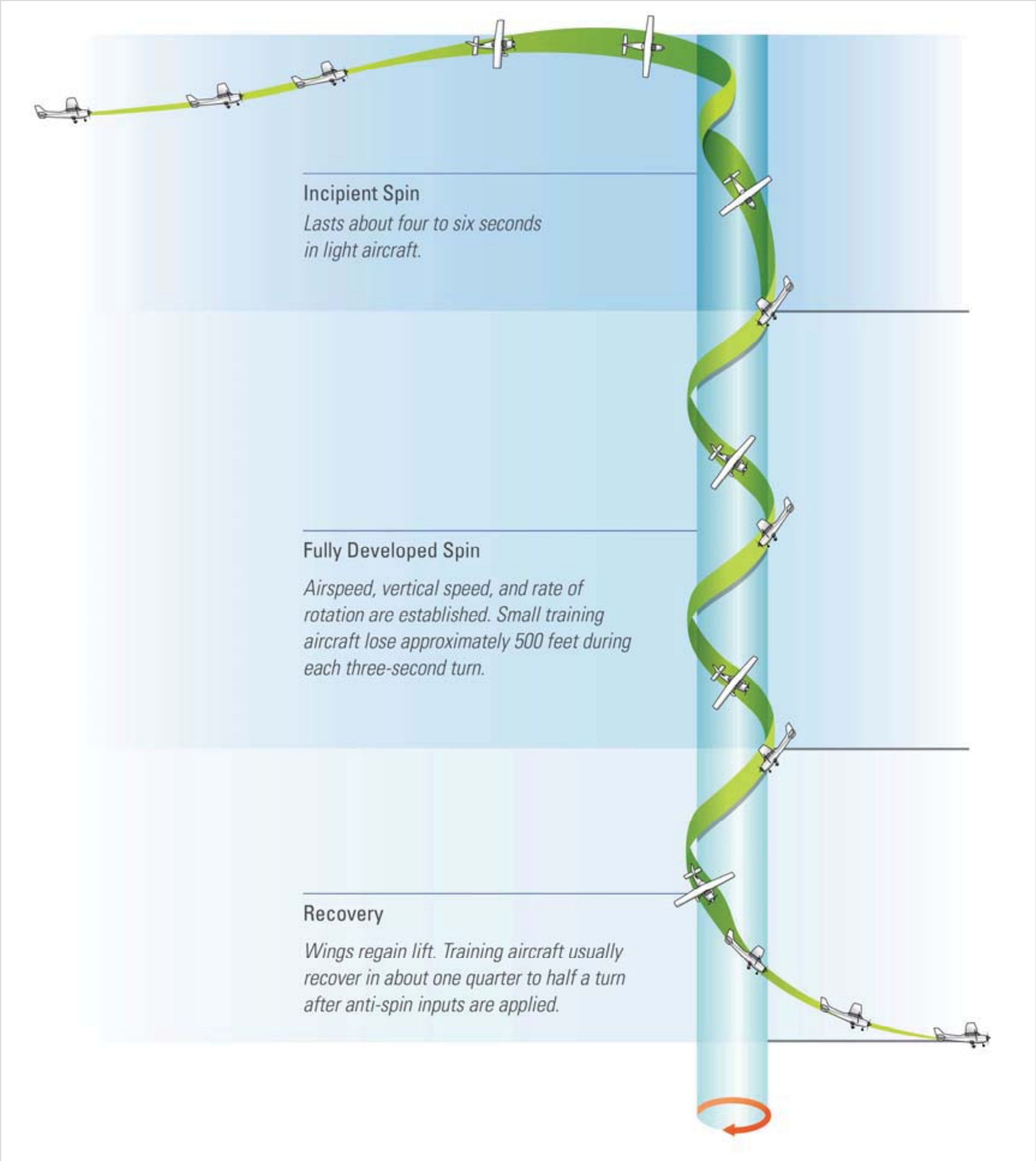

Figure 20 - Spin Phases

1.18.3. Aircraft Spin Recovery on the Zlin Z 242 L Aircraft[6]

Aircraft Recovery from Spinning

This particular aircraft has several warnings and advisory notes concerning spinning and has a specific spinning warning placard in the cockpit about spinning with the flaps extended.

Incipient spin and its recovery manoeuvres are not mentioned or defined in the Zlin Z 242 L AFM.

Paragraphs 4.13.1.3 B and D of Chapter 4 of the AFM specify recovery techniques for ***normal spin*** and ***unintentional spin***, respectively.

[6] Airplane Flight Manual Z 242 L Zlin Aircraft

Both require “full deflection against to the direction of rotation” of the rudder, prior to elevator inputs. (i.e. Yaw control followed by Pitch control).

Typical errors in spin recovery stated in paragraph E of Chapter 4 of the AFM are:

(1) Use the ailerons during entry, at spin and spin recovery.

(2) Inadequate or slow use of the rudder and/or elevator during spin recovery.

(3) Reversed order of rudder and elevator application (first elevator and then rudder). In this case autorotation does not stop. (i.e. Pitch control followed by Yaw control).

‘Incipient spin’ and ‘full spin’ recovery on Zlin Z 242 L as defined by HKAC

HKAC were requested to provide details on the exercises corresponding to the incipient and full spin recovery training delivered, including but not limited to the differentiation of incipient and full spin and the competencies required to be demonstrated.

Correspondence associated with the flights of 22 June and 7 July 2013 stated there were two different spinning exercises, with assessments on the respective performances.

HKAC advised that an ‘incipient spin’ recovery is defined as the recovery by a pilot before the aircraft enters into a full spin, when the pilot demonstrates competency to neutralise controls (ailerons, elevator and rudder) and recovers the aircraft back to straight and level flight.

For ‘full spin’ recovery, the pilot will have to demonstrate competency on recovery as per the Zlin Z 242 L normal spin recovery procedure and return the aircraft to straight and level flight.

Specific AFM Remarks Concerning Aerobatic Operation

Auxiliary tanks

The pre-flight check under AFM Section 4.13.1.1 prohibits fuel in the auxiliary tanks for aerobatic manoeuvres.

The post-accident examination could not determine the existence of fuel in the auxiliary tanks due to their damage and water submersion.

Battery

The pre-flight check requires proper fastening of the battery. The battery remained fastened, despite the mounting structure was displaced and deformed due impact.

Engine oil

AFM Chapter 1.19.3 specifies the engine oil level to be at maximum of six quarts for aerobatic flight.

However, engine oil quantity could be up to eight quarts after maintenance servicing, which is possible as the aircraft had recently undergone its annual inspection.

The aircraft manufacturer was consulted for the implication of the aircraft performing aerobatic flight with an oil level between six and eight quarts. The manufacturer confirmed that six quarts is the “middle level” and should not have had a significant impact on the accident flight.

Loose objects

The cushion was fastened to the seat frame with four fasteners.

Pre-flight check requires that cushion from the unoccupied seat for single flight to be removed. However, a cushion belonging to the right-hand unoccupied seat was discovered by the search and rescue team on the water surface. The aircraft manufacturer was thus consulted on the consequence if the cushion of the unoccupied seat was not removed during an aerobatic flight. They advised that “[the cushion] will never release spontaneously because of its strong and multiple fastening to the seat frame”. It was concluded that the cushion was unlikely to have detached in-flight and became a loose object obstructing the pilot.

Baggage

The pre-flight check requires baggage to be removed from the baggage compartment.

The compartment was found empty.

Placard

A placard located in the aircraft cockpit specifies the recovery action from normal spin according to the AFM:

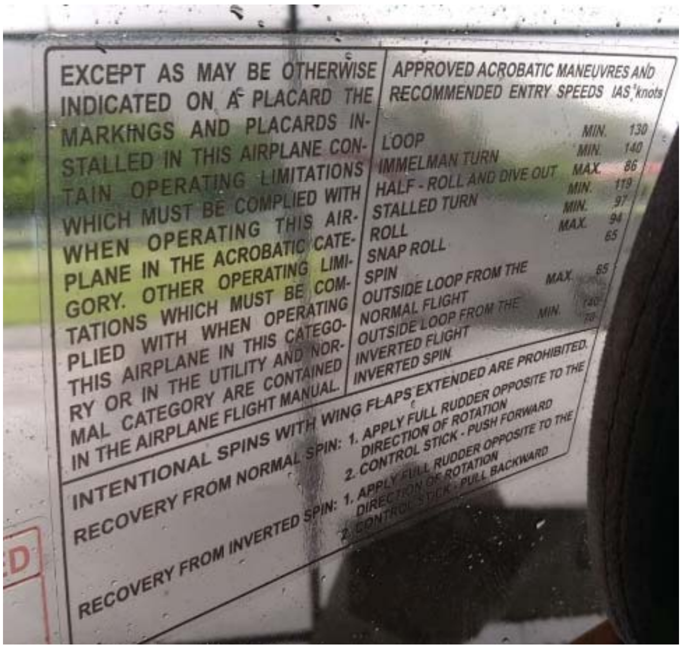

Figure 21 - Spin Recovery Action Placard

Disorientation during Aerobatics

Disorientation occurs when there is a conflict between the visual and vestibular sensations.

During the initial stages of a spin, the eye is able to remain oriented.

However, in a spin that continues beyond about two turns, disorientation often occurs and it will be very difficult for the pilot to make the correct recovery inputs, unless properly trained and experienced in spinning.

1.19. Useful or Effective Investigation Techniques

1.19.1. Flight track plotting

During the investigation, data from TMS TAR, which is one of the operational radars for air traffic control within the Hong Kong FIR, was used to reconstruct the flight path of this event.

In this event, the aircraft positions were obtained from the secondary surveillance radar component of TMS TAR.

The bearing and distance of the aircraft from the location of the TMS TAR were measured through interrogations to the aircraft’s transponder and its replies to the radar.

In addition, aircraft identity and pressure altitude information were reported from the aircraft during secondary surveillance radar interrogations.

These raw positional measurements and aircraft's reported information received by the TMS TAR indicated the flight path of the concerned aircraft down to 1,200 ft.

Note: The raw reported Mode C altitude (1200 ft) received by the TMS TAR was before barometric correction and is therefore not referenced to Mean Sea Level (MSL).

2. Safety Analysis

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

2.1. Aircraft Airworthiness

2.1.1. Aircraft Condition during the Flight

Based on the maintenance records and the FAL, the aircraft was airworthy at the point of departure from the airfield.

2.2. Airframe and Flight Control Analysis

2.2.1. Teardown Inspection of the wreckage

The aircraft's airframe was partially dismantled during the second stage of the investigation to verify the existing data and provide a factual basis for a possible causal theory for the loss of control inflight based on the structural investigation.

Flap Selector Lever

The position of the flap handle was found to be between "Flap Retracted" and "Flaps Take-Off" when the wreckage was discovered under the water.

There is also a witness mark on the flap pedestal at the 'Flap Retracted' retracted position.

Due to the damage of the flight control linkages and without the provision of a flight data recording system, reliable evidence on the settings of the primary control surfaces, including the actual flaps position at impact could not be conclusively determined.

Aircraft Flap Positions

A photo taken prior to the submerged aircraft's recovery shows that the flap control lever was not in the retracted position at the point of recovery.

The flap position provides an indication of the configuration of the aircraft prior to the onset of the spin.

As there is a specific warning for this aircraft that spinning with flaps is prohibited, determination of the flap position was considered an investigation requirement.

To determine the physical position of the flaps at impact, the investigation examined the aircraft structure for residual evidential indications (generally referred to as witness marks) which are indicative of the position of the various flight controls and assemblies at the point of the aircraft's impact with the sea.

Figure 22 - Aft View of the Recovered Airframe

The non-uniform lateral deformation of the flaps in conjunction with the position of the flaps and the damage indicates the flaps sustained high energy damage due to impacting the sea during the rotation of the spin.

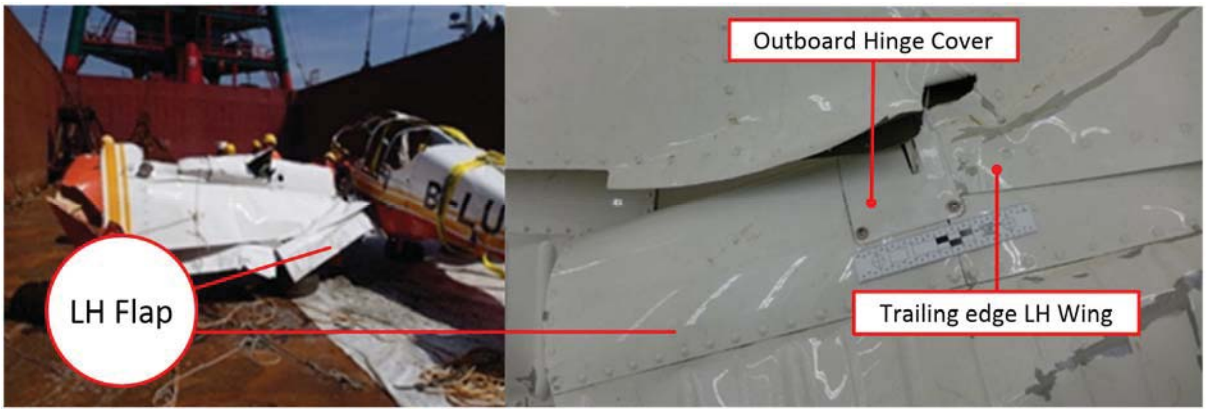

Figure 23 - Flap Damage

The trailing edge of the left wing is under the outer hinge cover of the flap.

Left Hand Flap Position

As the trailing edge of the left wing was under into the outer hinge cover of the flap, this sequential deformation of the affected panel is improbable if the flap is retracted as the leading edge of the flap sits underneath the trailing edge of the wing, forward of this point.

Right Hand Flap Position

The right flap assembly deformation is more extensive than the left flap assembly.

There are no witness marks found underneath the trailing edge of the right wing, indicative that the flap was not in the retracted position (the flap has a flush profile with the wing at impact which would leave residual witness marks on impact).

Examination on the outer flap link of the right flap indicates deformation upward and backward unseating from the lower bolt while still attached to the flap.

As the flap is connected to the flap link, the load is induced during the impact.

As the aircraft impacted the sea it generated sufficient force to deform and unseat the outer flap link which occurs if the flap is extended.

As the continuity of the left and right flap extension mechanism was verified, the flaps would have extended symmetrically.

Both flaps were deformed upward and to the right, indicating a right vector of the resultant impact force.

The right vector is the result of the right yaw of the aircraft during the spin, consistent with a right rotation at impact.

Control Column (Aileron and Elevator Control)

Assessment of the witness mark on the control stick countershaft (at impact) was conducted using an exemplar aircraft as reference.

a. The countershaft connects the two control columns.

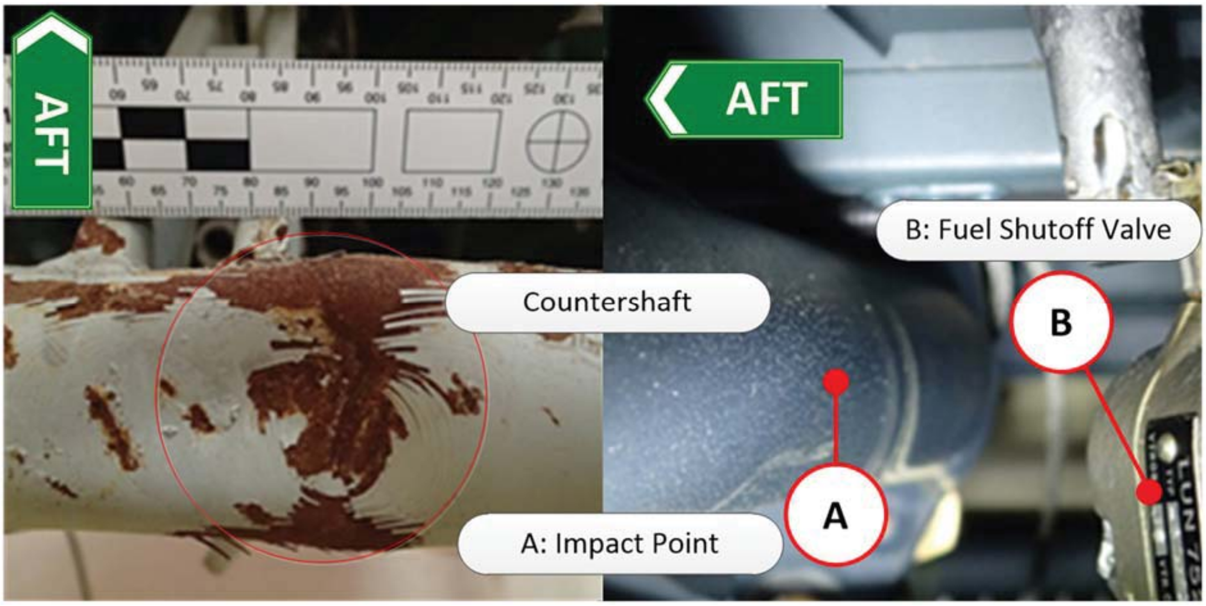

Figure 24 - Control Countershaft Damage

The fuel shutoff valve is located on the same horizontal plane and directly in front of the countershaft.

As the impact was from the front of the aircraft, the fuel shutoff valve (B) would hit the countershaft (A), leaving a witness mark or deformation of the shaft following impact.

In addition, to determine the position of the control stick when the witness mark was made, the control column was moved full travel from full forward to full aft, examining the locus of the countershaft.

It was found that only when the control stick was held at the full aft position, at which the relative position of the fuel shutoff valve and the countershaft would have matched the impact location of the witness mark, indicating the control column was at the full aft position at the point of impact.

b. Elevators:

During normal operations the leading edge of the elevator will not contact the elevator support hinge brackets.

The witness marks indicate that the elevator was at the full trailing edge up position at impact.

c. Vertical Stabiliser and Rudder:

The vertical stabilizer and the rudder deformation is consistent with a high speed water impact with the deformation indicating the rudder was deflected to the left at the point of impact.

Note: Application of the opposite rudder is one of the components of the recommended spin recovery technique for this aircraft.

Throttle Lever Positions

The left and right engine throttle levers extended 20.3 cm/eight inches and 12.7 cm/five inches, respectively, from the deformed instrument panel.

The idle position of the throttle levers should be about 12.7 cm/five inches as a reference from the instrument panel.

The discrepancy of the displacements was due to the deformed instrument panel.

Based on the engine and propeller test results, it is highly probable that the engine was at idle on impact.

2.3. Rate of Descent

2.3.1. Radar Data Derived Information

The radar data is used to determine the rate of descent of the aircraft.

Within the 20 s between 14:09:37 hrs and 14:09:57 hrs, the aircraft descended 2,300 ft, from 2,600 ft down to 300 ft AMSL at an increasing rate, with the highest rate of descent over 7,000 ft/min.

The last 300 feet was not recorded on the radar data, interpolation of the available data is linear with a constant rate of descent until impact.

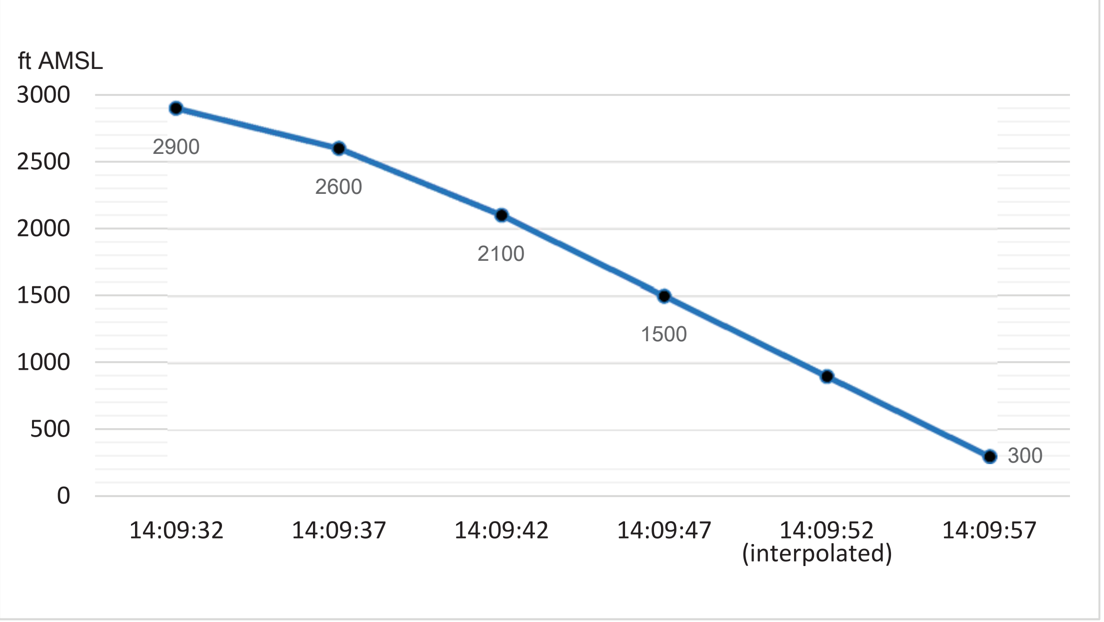

Table 5 - Descent Rate/Altitude (ft) vs Time (s)

2.4. HKAC Spin Training

2.4.1. Development of the aerobatic course syllabus on Zlin Z 242 L

Syllabus

Although the HKAC were unable to provide the syllabus of the aerobatic course for the Zlin Z 242 L, HKAC advised the syllabus of the aerobatic course on Zlin Z 242 L was devised referring to the copies of the references provided.

The investigation noted that the PowerPoint briefing entitled ‘Aerobatics’ did not cover specific entry or recovery techniques on individual aerobatic manoeuvres, for example spinning.

The Zlin guide evidenced by the investigation was a previous revision of the AFM (Rev No. 10 dated 15 April 2003), and not the current standard.

2.4.2. Pilot’s Training - Incipient spin training on Zlin Z 242 L

Pilot Training Background

As per the incipient spin recovery as defined and provided by the HKAC, the pilot would have demonstrated competence on the flight to neutralise controls (ailerons, elevator and rudder) and recover the aircraft back to straight and level before the aircraft entered into a full spin.

Incipient spin and recovery manoeuvres are not defined in the Zlin Z 242 L AFM as intentional spinning is prohibited.

The manual specifies recovery techniques for unintentional and normal spin, both of which require 'full deflection against the direction of rotation' of the rudder, prior to elevator inputs'.

The incipient spin and the recovery manoeuvres that the pilot was taught and assessed as satisfactory on this flight were different from the aircraft AFM.

2.5. Regulatory Oversight – Flight Instructor (FI) Rating Test

2.5.1. Flight Instructor(s)

The Zlin Z 242 L (B-LUR) was introduced into the HKAC fleet during February 2013.

Two HKAC aerobatic instructors had been renewing their FI rating on B-LUR.

As flight test items '11.1 Basic spins and 11.2 Advanced spins' of the FI rating are a conditional phase of the FI rating test, their knowledge and competence on basic spins and advanced spins with respect to B-LUR flight tests would be a requirement.

2.5.2. Enforcement of Regulation - FI Rating Test

Approval of FI rating renewal test

No test result was made on the Flight Test item E12.2 – Engine failure after take-off for the combined FI renewal and the removal of the 'Aerobatic Flying (except spinning)' restriction on a Zlin Z 242 L dated 17 October 2015, although the application was approved by CAD.

The result for a test item not shown on the DCA 270 is not an indication that the test exercise was not performed, this is an anomaly as the required document verification from CAD as proof that the test exercise had been performed was not provided.

2.6. Weight and Balance

The pre-flight Centre of Gravity (CG) calculation record of the accident flight was not available, and the quantity of fuel remaining cannot be ascertained due to the rupturing of all fuel tanks and water submersion of the aircraft, the exact quantity of the fuel on board was not known.

Based on the information provided by the pilot on the previous flight, analysis that the auxiliary tanks were not filled, an estimate of 90 L of fuel was on board at the time of the accident, the calculation gave a total mass at impact of approximately 915 kg and a CG of 23.6% of MAC which is within the limits of the aircraft.

2.7. Survivability

In accordance with the Type Certificate Data Sheet of Zlin Z 242 L, EASA.A.027, the aircraft conforms to Federal Aviation Regulations (FAR) Part 23 specification.

FAR 23.561 and FAR 23.562 defined the emergency landing conditions by design that the aircraft, although it may be damaged in emergency landing conditions, the structure must be designed to give each occupant every reasonable chance of escaping serious injury in a minor crash landing.

However, without the relevant flight data, the impact load could not be determined, in particular when hitting the water surface.

For this event, the manufacturer advised that a calculated impact force '*may not have ultimately appropriate real value*'.

Nevertheless, based on the witness description of an almost vertical impact and the severely damaged nose section of the aircraft, it is evident that the accident was outside the survivable crash envelope of the aircraft as described in the certification specifications for an emergency landing.

2.8. Medical Reports

The pathology reports refer to the level of coronary heart disease of the pilot, which may have caused a medical condition in flight.

It is not possible to determine if the pilot experienced a medical condition in flight based on the available evidence.

Both pathology reports refer to ‘control type injuries’ which can provide with a reasonable level of confidence an indication that the pilot was controlling the aircraft with the flight controls at the time of impact.

2.9. Search and Rescue

During the accident, there was no distress signal received.

The ELT was armed. Activation on impact would have occurred.

ELT signals are attenuated underwater; the signals would not have been received irrespective of the detachment of the antenna.

In this accident, witnesses were able to help locate the wreckage position.

2.10. Specific AFM Remarks Concerning Aerobatic Operation

The aircraft lost control inflight; this resulted in a fully developed spin from which the aircraft did not recover prior to the impact with the sea.

The AFM specifies certain limitations for the aircraft mass and the centre of gravity, in particular with regard to the aircraft configuration.

The probability that a configuration anomaly may have precluded a recovery from the fully developed spin was analysed based on the AFM requirements concerning aerobatic operation, i.e. the quantity of fluids or security of objects in the auxiliary tanks, the engine oil quantity, any loose objects, battery security and if the baggage compartment was loaded or unloaded, based on the available information the AFM requirements were satisfactory.

3. Conclusions

3.1. Findings

3.1.1 The aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures.

3.1.2 The pilot was licensed and qualified for the flight in accordance with the existing regulations.

3.1.3 The pilot had made the inflight decision to remain in the TOLO area and not the designated aerobatics area, due to the weather conditions in the area.

3.1.4 The weather conditions were within the limits for VFR operations.

3.1.5 There was no distress or emergency call made by the pilot.

3.1.6 The fuel quantity was sufficient for the flight.

3.1.7 The mass and the centre of gravity of the aircraft were within the prescribed limits.

3.1.8 There are no evidence that the auxiliary tanks, engine oil quantity, loose objects, battery, and baggage of the aircraft that might have precluded it from recovering a fully developed spin.

3.1.9 From the structural analysis, high rate of descent, and the witnesses' observations, the aircraft had entered into and not recovered from a fully developed spin before impact.

3.1.10 The aircraft was destroyed by impact forces.

3.1.11 The accident was not survivable due to the magnitude of the deceleration forces.

3.1.12 All of the wreckage was located, all control surfaces were accounted.

3.1.13 It is probable the control column was displaced fully aft, in elevator trailing edge up position (aft) at impact.

3.1.14 The throttle levers were at idle on impact.

3.1.15 The flaps were extended or partially extended on impact.

3.1.16 ELT signals are attenuated underwater; the signals would not have been received irrespective of the detachment of the antenna in this accident.

3.1.17 Cap. 448C does not require the HKAC to implement an SMS.

3.1.18 There is no legal requirement for the CAD to approve or accept the syllabus of the aerobatic course.

3.1.19 Supporting evidence that the syllabus of the aerobatic course was established during 2013 while the pilot was taking his Zlin Z 242 L type conversion training was unavailable.

3.1.20 The incipient spin recovery procedure of the Zlin Z 242 L as taught by the HKAC was not described in the organisation's documentation.

3.1.21 The incipient spin recovery procedure adopted by the HKAC is not referenced in the Original Equipment Manufacturers (OEM) Zlin Z 242 L AFM.

3.1.22 'Basic spins' and 'advanced spins' are mandatory flight test items on the CAD 270 form for FI rating initial and renewal tests.

3.1.23 The aircraft was not required by the current regulation to be equipped with a Flight Data Recorder, a Cockpit Voice Recorder, and an Airborne Image Recorders; or subscribe to an internet based Real-Time Aircraft Tracking & Communication service.

3.2. Determination of Cause

In the absence of flight recorder data, it is not possible to absolutely determine the circumstances of the aircraft entering into and not recovering from a fully developed spin.

This includes the spin onset and duration of the g forces that might lead to disorientation or any other physiological effects on the pilot during the spinning, or if there were any typical spin recovery errors as stated in the AFM regarding spin recovery.

However, based on the available information, it is probable that the pilot having determined the minima for spin training were outside of the allowable limitations cancelled the intended spin exercise and sought to use the time available for alternative aircraft handling exercises.

The pilot may have elected to practice stall recovery exercises in various flap configurations and power settings while in the training area (stalling in clean, partial, and full flap configurations with power settings set to represent the intent of the exercise).

It is possible during one of the stall and recovery exercises with the aircraft in an approach or landing flap configuration, the aircraft entered an inadvertent incipient spin that progressed into a fully developed spin from which the pilot was unable to recover.

3.3. Contributing Factors

3.3.1. Safety Management System (SMS)

The HKAC is not legally required to implement an SMS.

Systemic risks to safety can be captured through an effective, wide ranging SMS process. The absence of a regulatory mandated SMS, effectively managed and monitored, does not allow for the identification of systemic or emergent risks to be captured and operationally mitigated.

3.3.2. Dissimilar Spin Recovery Techniques

The incipient spin and the recovery manoeuvres that the pilot was assessed on during his Zlin Z 242 L conversion training differed from the recommended procedures in the original equipment manufacturers AFM.

GFO-02 instructs pilots to be familiar with the procedural differences, including the difference between the incipient spin recovery methodology adopted by the HKAC and the manufacturers recommended procedure in the aircraft AFM.

3.4. Other Findings

3.4.1. Regulatory Oversight

Due to the current limitations of Cap. 448C with regard to the Regulator’s ability to proactively oversight the HKAC, the Regulator’s safety oversight of the operator’s procedures, standardisation, operations, and risk management was subsequently limited in scope and by extension limited in effectiveness to control risk.

4. Safety Recommendations

Safety Recommendation: 03-2020

4.1. Safety Recommendation

CAD to review and assess the current limitations of Cap. 448C with a view to updating the legislation to enable efficient regulatory oversight.

Safety Recommendation Owner: Civil Aviation Department, Hong Kong

Safety Recommendation: 04-2020

4.2. Safety Recommendation

CAD to review and define the FI rating test requirements for ‘basic spins’ and ‘advanced spins’ for dissimilar aircraft types with respect to the AFM.

Safety Recommendation Owner: Civil Aviation Department, Hong Kong

Safety Recommendation: 05-2020

4.3. Safety Recommendation

CAD to consider mandating the carriage/installation of image/GPS recording devices on Group A aeroplanes in conjunction with the primary certification authorities of the States of Manufacture and Design.

Safety Recommendation Owner: Civil Aviation Department, Hong Kong

Safety Recommendation: 06-2020

4.4. Safety Recommendation

HKAC should review GFO-02 and all GFOs relating to spinning for dissimilar aircraft types in consultation with the CAD.

Safety Recommendation Owner: Hong Kong Aviation Club, Hong Kong

5. Additional Safety Actions

Whether or not the AAIA identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk.

The AAIA has been advised of the following proactive safety action in response to this occurrence.

5.1. Proactive safety action taken by:

5.1.1. Civil Aviation Department

Safety action taken:

The CAD have continuously reviewed the HKAC operations as a continuous monitoring process, assisting the HKAC with the implementation of recommendations.

Safety action taken

CAD have conducted a safety seminar to the HKAC members to promote safety, including the promotion of the SMS as a process to manage safety and risk.

Safety action taken

CAD have amended the workflow for the form DCA 270 to optimise the process.

5.1.2. Hong Kong Aviation Club

Safety action taken:

A new book out form requiring pilots to complete information on the nature of the flight and weight and balance information is now required for authorising a flight.

Safety action taken:

The introduction of a standardised exercise list for the conversion on complex/aerobatic aircraft is now available.

6. General Details

6.1. Occurrence details

Date and time:	27th February 2016, at 14:10 (Local)	
Occurrence category:	Accident	
Primary occurrence type:	Loss of Control Inflight (LOC-I)	
Location:	Tolo Channel, Hong Kong SAR	
	Latitude: 22° 28.178' N	Longitude: 114° 17.759' E

6.2. Pilot Information

Licence details:	Private Pilot (Aeroplane) Licence
Endorsements:	Group A – All single-engine aeroplanes (landplanes) of which the maximum total weight authorised does not exceed 5,700 kg
Ratings:	Flying Instructor's (FI) rating in Aeroplanes (landplanes) in Group A Limitations: The holder of this rating may not give flying instruction in:- Aerobatic Flying (except spinning) Night Flying Radio Navigation and Instrument Approaches
Medical certificate:	Class Two / Valid until 30 June 2016 Corrective lenses to be worn and additional spectacles to be available
Aeronautical experience:	1,848 hours (of which 1,478 hours were in command; 103 hours on Zlin Z 242 L, and 1,196 hours were instructional)
Certificate of Experience:	Valid until 31 December 2016

6.3. Aircraft details

Manufacturer and model:	Zlin Z 242 L	
Registration:	B-LUR	
Engine	Lycoming AEIO-360-A1B6	
Propeller	MTV-9-B-C/C	
Operator:	Hong Kong Aviation Club	
Serial number:	0791	
Type of operation:	Recreational	
Departure:	Shek Kong Airfield, Hong Kong SAR	
Destination:	Shek Kong Airfield, Hong Kong SAR	
Persons on board:	Crew – 01	Passengers – Nil
Injuries:	Crew – 01 (Fatal)	Passengers – Nil
Aircraft damage:	Destroyed	

7. Abbreviations

AE	Authorised Examiner
AFI	Assistant Flying Instructor
AFM	Airplane Flight Manual
AIR	Airborne Image Recorder
AMS	Aircraft Maintenance Schedule
AMSL	Above mean sea level
AMU	Acceleration Monitoring Unit
Annex 13	Annex 13 to the Convention on International Civil Aviation
AOPA	Aircraft Owners and Pilots Association
ATC	Air Traffic Control
BFU	German Federal Bureau of Aircraft Accident Investigation
CAD	Civil Aviation Department Hong Kong
Cap. 448B	Hong Kong Civil Aviation (Investigation of Accidents) Regulations
Cap. 448C	Air Navigation (Hong Kong) Order 1995
CG	Centre of gravity
º	Degree
EASA	European Aviation Safety Agency
ELT	Emergency Locator Transmitter
FAL	Flight Authorisation Log
FAR	Federal Aviation Regulations
FI	Flying Instructor (Aeroplanes)
FIE	Flying Instructor Examiner
FIR	Flight Information Region
FIS	Flight Information Service
FOB	Flying Order Book
FSCC	Fire Services Communications Centre
FSD	Fire Services Department
ft	Feet
ft/min	Feet per minute
g	Normal acceleration
GFO	General Flying Order
GPS	Global Positioning System
HKAC	Hong Kong Aviation Club Limited
HKAIP	Hong Kong Aeronautical Information Publication
HKASP	Hong Kong Aviation Safety Programme
hPa	Hectopascal
HP	Horsepower
hrs	Hours
ICAO	International Civil Aviation Organization
kg	Kilograms
km	Kilometres
kt	Knots (nautical miles per hour)
L	Litres
m	metres
MAC	Mean Aerodynamic Chord
MBY	Mirs Bay
MHz	Megahertz

NOTAM	Notice to airmen
NTSB	National Transportation Safety Board of the United States
POH	Pilot Operating Handbook
QNH	Pressure setting to indicate elevation above mean sea level
RAF CAM	Royal Air Force Centre of Aviation Medicine
RTF	Radiotelephony
s	Seconds
SMS	Safety Management System
SR	Safety Recommendation
SSR	Secondary Surveillance Radar
TMS	Tai Mo Shan
UCARAs	Uncontrolled Airspace Reporting Areas
UK	United Kingdom
USA	United States of America
VFR	Visual Flight Rules
VHF	Very High Frequency

8. Table of Figures

9. Air Accident Investigation Authority

The AAIA is an independent Government Authority and is entirely separate from the transport regulators and service providers.

The AAIA's function is to improve safety and public confidence in the aviation transport through excellence in: Independent investigation of transport accidents and other safety occurrences, Fostering safety awareness, Engagement with the industry.

The AAIA is responsible for investigating accidents and serious incidents and other transport safety matters involving civil aviation in Hong Kong, as well as participating in overseas investigations involving Hong Kong registered aircraft.

A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The AAIA performs its functions in accordance with the provisions of Cap. 448B,and where applicable, relevant international agreements.

9.1. Developing a safety action plan

Central to the AAIA's investigation of aviation transport safety matters is the early identification of safety issues in the transport environment.

The AAIA prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues.

Nevertheless, the Chief Inspector of Accidents may use his power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action.

As with equivalent overseas organisations, the Chief Inspector of Accidents has no power to enforce the implementation of its recommendations. It is a matter for the body to which an AAIA recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the AAIA issues a safety recommendation to a person, organisation or agency, they must provide a written response, usually within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

Check the Air Accident Investigation Authority website for information, reports and updates

https://www.thb.gov.hk/aaia/eng/index.htm

The Air Accident Investigation Authority 24/7 Duty Investigator Hotline:

Tel: (852) 9518 5800

Email: ACCID@thb.gov.hk

Fax: (852) 2910 6049