FINAL REPORT

AAIU Synoptic Report No: 2008-003
AAIU File No: 2007/0050
Published: 08/02/2008

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 4 June 2007 appointed Mr. Leo Murray as the Investigator-in-Charge to carry out an Investigation into this Accident and prepare a Synoptic Report.

Aircraft Type and Registration:	Kolb Twinstar Mk. IIIA, G-BUZT
No. and Type of Engines:	1 x ROTAX 582
Aircraft Serial Number:	PFA 205-12367
Year of Manufacture:	2001
Date and Time (UTC):	4 June 2007 @ 16.13 hrs
Location:	Killoughrum, near Enniscorthy, Co. Wexford
Type of Flight:	Private
Persons on Board:	Crew – 1 Passengers – Nil
Injuries:	Crew – 1 (Serious)
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	JAA Private Pilot's Licence (UK)
Commander's Details:	Male, aged 60 years
Commander's Flying Experience:	105 hours, of which 6 were on type
Notification:	Shannon ATC Watch Manager
Information Source:	AAIU Field investigation

SYNOPSIS

The aircraft departed a private airfield on a local flight and proceeded in a northerly direction at an altitude of approximately 1,000 ft. After approximately 20 minutes flying time the engine stopped without warning. The pilot, the sole occupant of the aircraft, was unable to restart the engine in the time available. In the subsequent forced landing the aircraft impacted heavily with the ground and was severely damaged. The pilot suffered serious injuries.

FINAL REPORT

1. FACTUAL INFORMATION

1.1 History of the flight

Prior to the accident flight the pilot refuelled the aircraft with unleaded Mogas sourced from a local garage forecourt. With the good weather that day, the pilot planned a local solo flight with the intention of flying north towards Bunclody, where his home was located. A pre-flight check was carried out by the pilot. The aircraft took-off from Taghmon[1] in Co. Wexford at 15.53 hrs and climbed to an altitude of 1,000 ft. The flight progressed without incident until nearing the town land of Killoughrum. Here, at an altitude of approximately 900 ft, the engine lost power and stopped. The pilot immediately attempted to re-start the engine. He moved the fuel selector to change fuel tanks but was unsuccessful in re-starting the engine in the time available. As a forced-landing was inevitable, he turned the fuel supply off, and searched for a suitable field for landing. The field selected was large, approximately 900 metres by 700 metres, with a crop of barley standing about 40-50 cm high. Apart from a low hedge there were no obstacles on the approach path. The aircraft cleared the boundary hedge, made an initial impact with the left main wheel 4.7 metres beyond the hedge, and impacted heavily a further 7.3 metres into the field itself (**Photo No. 1**).

Photo No. 1: Final position of G-BUZT

The impact severely distorted the main undercarriage and lower fuselage around the cockpit area. Substantial deceleration forces were experienced by the pilot who suffered serious injuries as a result. Two witnesses were quickly on the scene; they rendered assistance to the pilot and called the emergency services. The scene was secured by An Garda Síochána.

[1] A Private airfield operated by the *Society of Amateur Aircraft Constructors* (SAAC)

1.2 Field Investigation

The AAIU was informed of the accident by the Watch Manager at Shannon at 16.59 hrs. An Inspector of Air Accidents travelled to the scene. The initial inspection revealed the aircraft to be substantially intact with severe damage to the fuselage structure in the cockpit area. The wings and empennage were relatively undamaged. In the cockpit, the fuel selector was noted with the handle of the selector lever in line with the 'OFF' placard. Ignition Switches A and B were noted 'ON' with the starter key in place. The battery 16A breaker/switch was found in the ON position and the alternator breaker/switch was found OFF. The flap selector lever, situated between the pilot seats, was noted in the 'UP' detent. The elevator trim control, situated to the left of the pilot seat, was noted in the 5th aft detent. The control column had only limited movement due to distortion of the fuselage structure.

The left fuel tank contained 4½ US Gallons of fuel, while the right tank contained only a small quantity of unusable fuel (**Photo No. 2** and **Photo No. 3**). There was no evidence of any fuel leakage from the fuel tanks or lines. Aft of the cockpit, the fuel line was opened for inspection at the in-line fuel filter coupling and revealed only a trace amount of fuel. The fuel filter itself was found to be clean and free of debris.

Photo No. 2: Left Tank – approx. 4 ½ USG

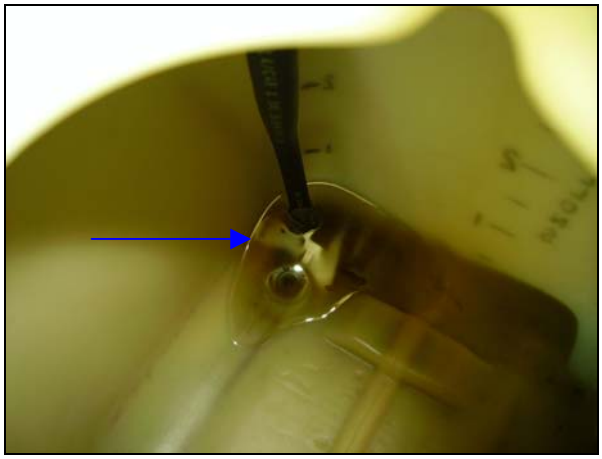

Photo No. 3: Right Tank – unusable fuel

For site safety reasons both ignition switches were placed to 'OFF' and the aircraft's battery disconnected and removed. The engine appeared undamaged and turned over with compression when the propeller was rotated.

The pilot was using a '*Garmin GPS 196'* which was found loose in the cockpit and de-powered. The unit was recovered by the Investigation to download its data. A number of witnesses to the accident were located and interviewed. Arrangements were then made to move the wreckage to the AAIU facility at Gormanston for further examination.

1.3 Aircraft Information

1.3.1 General

The Twinstar Mk. III is a two-seat high-wing monoplane of pusher engine configuration. It is manufactured by Kolb Aircraft, Inc in the USA and supplied as a kit for amateur construction. Assembly of G-BUZT was completed in the United Kingdom during 2001 under the auspices of the Popular Flying Association (PFA). The aircraft was powered by a single liquid-cooled ROTAX Type 582 two-stroke engine, developing 48kW (64hp) and driving a three-bladed 'Ecoprop' propeller.

The design utilises traditional cable and push-pull tube control systems. The wing differs from earlier versions with strengthened wing spars, a greater number of wing ribs and stronger drag struts. The wings and tail are designed to fold to facilitate storage and transport. The landing gear is a tailwheel configuration. The cockpit structure is factory welded 4130 Molybdenum steel tubing. Accommodation is provided for two individuals in side-by-side seating with a single control column positioned between the two seats. Both seat positions have conventional rudder pedals; in G-BUZT the pedals on the left side are equipped with hydraulically actuated brakes.

The Twinstar cruises at a speed of 60 Knots (kts) indicated airspeed (IAS). Stall occurs between 33 and 35 kts depending on weight. The type has gentle stall characteristics. From straight and level flight, as air speed reduces to the stall there is some sink, further reduction in airspeed results in a gentle nose drop at about 34 kts. The aircraft gains speed and resumes flying with a reduction of stick back pressure. In an engine out condition, the best glide ratio occurs at 56 kts.

1.3.2 The Fuel System

The fuel system on G-BUZT comprises two separate fuel tanks arranged side-by-side behind the cockpit seats. Each tank has a capacity of 5 US Gallons. The tanks are made of translucent material, allowing the fuel contents to be checked in flight by reference marks on the sides of each tank. A small mirror facilitates viewing of the left tank, as it cannot be seen directly by the pilot in the left seat. A tube in each tank draws fuel through shut-off valves (cable-tied to the open position) through rubber priming bulbs to a three-position fuel selector situated behind the pilot on the aft bulkhead. The priming bulbs are not accessible in flight.

A single fuel line from the fuel selector supplies fuel to two float-type carburettors situated on the right-hand side of the engine. This fuel line incorporates a fuel filter, which is inspected by opening the brass coupling and removing the filter block. A gauge situated on the right-hand side of the cockpit panel shows fuel system pressure.

The fuel selector has three positions each identified by a placard, with fuel being drawn from the 'LEFT TANK', the 'RIGHT TANK', or 'OFF'. A tank is selected by rotating the *pointer* of the selector lever towards the selected tank. A collar underneath the selector lever is designed to allow only 180 degrees of travel to the selector lever, i.e. between 'RIGHT TANK' and 'LEFT TANK' selection.

1.4 Technical Investigation

1.4.1 Engine testing

Generally the engine was found in good condition and turned over freely with compression evident. The engine block showed no signs of damage or leaks. Both carburettors were opened for inspection, revealing only trace amounts of fuel in the carburettor bowls. The spark plugs were removed and all were found to be in good condition. The radiator expansion bottle showed signs of the radiator overheating at some point in the past. The oil tank contained sufficient oil. The propeller blades and hub were then examined and revealed no defects. The aircraft battery was re-installed.

Examination of the fuel selector revealed the selector lever to be 180 degrees out of correct position. As can be seen in **Photo No. 4**, the handle of the selector lever is aligned with the 'OFF' placard instead of the pointer. It was possible to rotate the selector lever through a full 360 degrees as the collar stop adjustment screw was not tightened sufficiently to restrict lever travel.

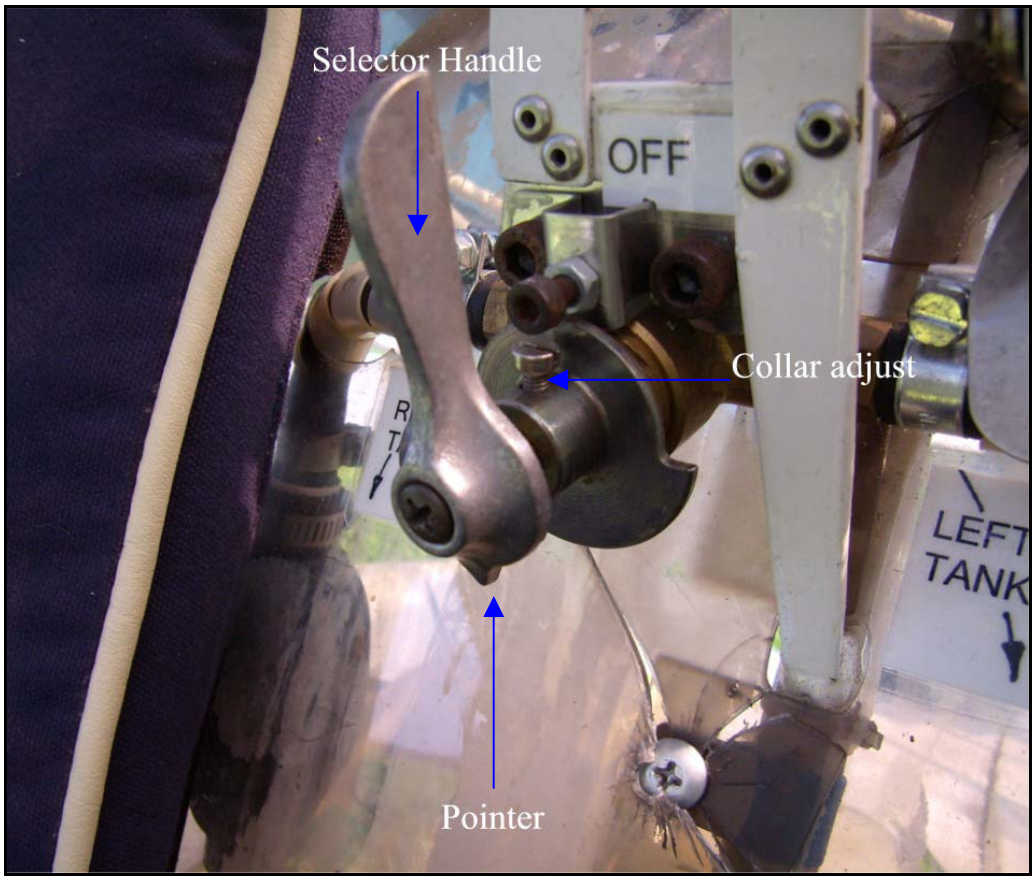

Photo No. 4: Fuel Selector

To facilitate engine testing the fuel selector lever was now positioned so as to draw fuel from the left tank. The fuel line was primed by means of a priming bulb above the tank. With the engine ancillary components re-assembled, the engine was started and ran without difficulty.

1.4.2 Flight Controls

The flight controls, including the flap and elevator trim systems were examined for control continuity and freedom of movement. Apart from stick movement being restricted due to impact damage, no defects were found with the flight controls, linkages, or flight control surfaces.

1.4.3 Fuel

On 18 October 2005, the engine was approved to run on unleaded petrol to BS EN 228 95 RON in Accordance with Airworthiness Notice 98C, issued by the UK Civil Aviation Authority (CAA). An advisory letter from the Popular Flying Association (PFA) Chief Engineer to members outlined the procedure for obtaining this approval. The letter also included practical guidance for PFA pilots using unleaded Mogas. This letter and inspection checklist were kept by the pilot with the aircraft logbook. A fuel sample (yellow/orange in colour) from the left tank was sent to an independent laboratory for testing. The fuel was found to be consistent to its specification with no contamination present.

1.4.4 GPS Data

The GPS unit provided data sampling of the flight, which was useful to the Investigation. Of note was the marked decrease in airspeed after the engine stoppage. The GPS data reveals the groundspeed (and by implication the airspeed when the effects of wind are considered) steadily decreasing towards the stall after the engine stoppage (**Appendix A**).

1.5 Weather Information

An aftercast was requested from the Aviation Services Division of Met Éireann. Conditions pertaining in the area at the time of the accident were as follows:

Surface wind:	020 deg T at 7 kts
Gradient wind:	040 deg T at 10-14 kts
Cloud:	Scattered at 1,500 ft and broken at 2,000-3,000 ft. There is a possibility that some low stratus was drifting about the area resulting in a risk of lower cloud ceilings of circa 1,000 ft.
Visibility:	General visibility readings ranged 15-20 Km. However, a reduction in visibility to the 5-8 Km range could have been possible if any light rain or drizzle developed.
Weather:	RADAR imagery shows no echoes in the vicinity of the incident. However, some very light drizzle or rain may have developed for short periods of time.
Temperatures:	Air temp 15 ºC, dew point 12 ºC
Freezing level:	Circa 9,000 ft

1.6 Pilot Interview

The Investigation was particularly interested in the final moments of the forced landing manoeuvre, as the impact was more severe than would be expected. The pilot recalled switching fuel tanks and attempting to re-start the engine. With the re-start unsuccessful, he selected a suitable field for landing. Of note was his remark that, *'the aircraft would just not flare'* resulting in the aircraft impacting heavily with the ground.

The pilot holds a (UK) JAA Private Pilot's Licence (Aeroplanes) issued by the CAA with Single Engine Piston (Landplane) Rating, valid to 1 December 2007. His Medical Certificate, Class II, was issued by the IAA and was valid to 26 April 2008. In June 2006, the pilot visited Cumbernauld in Scotland where G-BUZT was then based and made several flights in the aircraft with the then owner. This flying time totalled just over 3½ hours. The pilot subsequently bought the aircraft and transported it by road to its new base at Taghmon Airfield in Co. Wexford. In the two months prior to the accident flight the pilot had completed a further 2 hours flying time in the Twinstar again accompanied by an experienced pilot. Prior to the accident flight the pilot had accumulated a total time of 5 hours 35 min in the Twinstar. All of this flight time was under the supervision of an experienced pilot.

1.7 Permit to Fly

G-BUZT was first registered in the UK on 1 July 1993 and to its present owner on 20 July 2006. Being an amateur-built aircraft it was issued with a *Permit to Fly* instead of a *Certificate of Airworthiness*. An application for the renewal of the Flight Permit was made to the PFA, with the inspection being carried out on 15 June 2006. This inspection, which also included a flight test, did not reveal any faults with the fuel system or its operation. The Permit to Fly essentially permits the pilot to operate an aircraft for recreation purposes under certain conditions. One of the conditions is that the aircraft may not be operated outside the state of registration (in this case the United Kingdom) without obtaining permission from the regulatory authority in the state it is to be flown, in this case the Irish Aviation Authority (IAA). Aeronautical Notice A.19 issued by the IAA, refers. Permission to operate the aircraft in Ireland on a UK Permit to Fly had not been sought.

1.7.1 Mandatory Permit Directive

Aircraft registered in the UK and operating under a *Permit to Fly*, are subject to Mandatory Permit Directives issued by the CAA. One such directive, MPD No.1997-010 issued on 11 December 1997, deals with the modification of the seat pan and cushion of the Twinstar MK. III. The following extract is of note:

'*There have been a number of serious accidents on the Twinstar MK. III where the aircraft have impacted the ground at high vertical speed but in a level attitude. Although the undercarriage design complies with BCAR Section S*[2]*, severe impacts of this nature can result in undercarriage collapse and subsequent serious spinal injuries to the occupants.*

This directive was complied with during the construction of G-BUZT.

[2] **BCAR Section S**: British Civil Airworthiness Requirements, Section S – Small Light aeroplanes, issued by the CAA Safety Regulation Group

2. DISCUSSION

This accident has two distinct areas to be considered, (a) the engine stoppage and (b) the failure of the aircraft to flare.

2.1 The Engine stoppage

The engine stoppage was as a direct result of the exhaustion of useable fuel in the right fuel tank. At some point in time prior to the accident flight, the fuel selector was rotated in the wrong direction against the stop while being positioned to 'OFF'. An individual, not familiar with the operation of the fuel selector, aligned the *selector handle* (not the *selector pointer*) with the 'OFF' placard, leaving the selector lever 180 degrees out of proper alignment. The loose collar stop adjustment allowed rotation of the lever beyond the stop. Following this, with the selector handle 180 degrees out of position, selection of either tank would appear to be indicated by the selector handle position and not by the pointer.

The pilot accepted that he had misunderstood the operation of the fuel selector. On the day of the accident flight the pilot believed he was drawing fuel from the left tank. In actual fact fuel was being drawn from the right tank, which at that point, contained less fuel. The engine stopped when the usable fuel level in the right tank became exhausted. By switching tanks after the stoppage, a re-start should have been possible as fuel was available from the left tank. But as no fuel remained in the fuel line, the only way to prime the line and carburettor bowls was to crank the engine using the starter, as the priming bulbs are not accessible in flight. As there was little time to accomplish this, a re-start of the engine in the circumstances would have been unlikely.

2.2 The failure to flare

Appendix A shows the last 5 minutes of G-BUZT airborne as recorded by the GPS unit. The recorded ground speed (when adjusted for effects of wind to give a 'probable IAS') and show the aircraft in a stalled condition from approximately 969 ft AMSL (663 ft AGL) to impact.

Following the engine stoppage, the Pilot attempted to re-start the engine. As he was carrying out this task the airspeed decreased very close to the stall. As the airspeed decayed the rate of descent would have increased. In order to obtain the best lift/drag ratio in this condition, the pilot would have had to lower the nose considerably to increase flying speed - an action not instinctive to any low-experience pilot. This action, while necessary to regain proper control of the aircraft, would have resulted in a great loss of height where little height was available. With the aircraft almost fully stalled crossing the boundary hedge it would not have had the aerodynamic capability to flare prior to touchdown. This resulted in the heavy impact with the ground.

Most of the Pilot's experience was on the Cessna 150. Although he completed a basic course on microlight aircraft his experience on this class and type of aircraft was low. More than half of the 5 hrs 35 mins on G-BUZT was gained 12 months before the accident. This lack of experience and currency on type was a primary factor in the accident.

3. CONCLUSIONS

(a) Findings

1. The aircraft had sufficient fuel and oil on board for the intended flight.
2. The fuel used was of the correct grade and free of contamination.
3. The primary flight controls, flap, and trim systems appeared to have no pre-accident defects.
4. The engine or propeller had no defects that caused, or contributed to, the engine stoppage.
5. The pilot was properly licensed for the flight.
6. The aircraft was properly registered in the United Kingdom.
7. The Engineering inspection and flight test for the renewal of the *Permit to Fly* carried out in June 2006 found the fuel system and its operation satisfactory.
8. Permission was not obtained from the IAA to operate the aircraft in Ireland on a *Permit to Fly* issued in the United Kingdom.
9. The collar stop on the fuel selector was found sufficiently loose to allow full 360-degree rotation of the fuel selector lever.
10. The fuel selector was found 180 degrees out of proper alignment.
11. The left fuel tank contained approx. 4 ½ US Gallons of fuel; the right fuel tank contained only a small quantity of unusable fuel.
12. During descent, the aircraft was slowed sufficiently for a partially stalled condition to exist from approximately 663 ft above ground level (AGL) to impact.
13. With the aircraft descending in a stalled condition it would not be possible to flare sufficiently prior to touchdown.
14. The Pilot was inexperienced on the type.

(b) Probable cause

Mismanagement of the fuel system, due to the fuel selector lever being 180 degrees out of proper alignment, led to exhaustion of the useable fuel in the right tank and stoppage of the engine.

(c) Contributory Factors

The Pilot's low level of experience on the type resulted in the aircraft being flown very close to the stall following engine stoppage. In this aerodynamic condition it was not possible to flare during the forced landing.

4. SAFETY RECOMMENDATIONS

This Report does not sustain any Safety Recommendations.

APPENDIX A

GPS Ref	Time (UTC)	Altitude (AMSL)	Ground Speed	Probable IAS	Course (Deg T)	Remarks
98	17:09	1,202 ft	48 Kt	54 Kt	350 T	cruising flight
99	17:09	1224 ft	49 Kt	55 Kt	356 T	
100	17:09	1199 ft	55 Kt	61 Kt	352 T	
101	17:10	1114 ft	56 Kt	61 Kt	359 T	
102	17:10	1073 ft	52 Kt	58 Kt	356 T	
103	17:10	1093 ft	55 Kt	61 Kt	355 T	
104	17:10	1068 ft	55 Kt	61 Kt	355 T	
105	17:10	1082 ft	51 Kt	57 Kt	358 T	
106	17:11	1096 ft	50 Kt	56 Kt	358 T	
107	17:11	1106 ft	50 Kt	56 Kt	001 T	
108	17:11	1096 ft	53 Kt	60 Kt	004 T	
109	17:11	1059 ft	54 Kt	61 Kt	003 T	
110	17:12	1038 ft	51 Kt	58 Kt	006 T	
111	17:12	1013 ft	53 Kt	59 Kt	351 T	
112	17:12	1005 ft	53 Kt	59 Kt	351 T	
113	17:12	983 ft	51 Kt	57 Kt	355 T	
114	17:12	986 ft	55 Kt	61 Kt	355 T	
115	17:13	948 ft	55 Kt	61 Kt	357 T	
116	17:13	947 ft	48 Kt	55 Kt	003 T	engine stoppage
117	17:13	969 ft	28 Kt	34 Kt	356 T	stalled condition
118	17:13	915 ft	29 Kt	34 Kt	344 T	
119	17:13	827 ft	27 Kt	33 Kt	357 T	
120	17:13	644 ft	30 Kt	33 Kt	318 T	
121	17:13	442 ft	3 Kt	0 Kt	259 T	impact occurs
122	17:14	306 ft				

Extract of data from Garmin GPS 196 on G-BUZT

- END -