Piper PA-28-140, G-BBLA

AAIB Bulletin No: 3/97 Ref: EW/C96/9/6 Category: 1.3

Aircraft Type and Registration:	Piper PA-28-140, G-BBLA
No & Type of Engines:	1 Lycoming O-320-E3D piston engine
Year of Manufacture:	1971
Date & Time (UTC):	25 September 1996 at 1238 hrs
Location:	2 nm west of Southport Pier
Type of Flight:	Instruction
Persons on Board:	Crew - 2 - Passengers - None
Injuries:	Crew - 2 - Fatal - Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Commercial Pilot's Licence with Flying Instructor's Rating
Commander's Age:	49 years
Commander's Flying Experience:	Approximately 7,350 hours (much of which were instructional hours on PA 28 variants)
	Last 90 days - 135 hours
	Last 28 days - 55 hours
Information Source:	AAIB Field Investigation

Background

Recoveries from fully developed spins are not required duringtraining for the Private Pilot's Licence but they remain in thesyllabus for pilots who aspire to be a flying instructor. In thisaccident the commander was training another pilot to become anassistant flying instructor. The trainee, a retired airline TrainingCaptain with some 13,000 hours of flying experience, had verylittle recent experience of light single-engined aircraft andprobably had not practised spinning for many years. At the timeof the accident the weather was suitable for spinning; the cloudstructure was two octas base 3,000 feet and the visibility was23 kilometres.

History of the flight

The club-owned aircraft took off from Royal Air Force Woodvaleat 1206 hrs and changed frequency to Warton Approach for a FlightInformation Service whilst carrying out general handling exercises.About 15 minutes after take off the instructor informed ATC that"WE'RE JUST LEAVING TWO THOUSAND FEET NOW... WE'D LIKETO CLIMB TO FIVE SIX FOR SOME SPINNING FOR THE NEXT FIVE OR TENMINUTES IN MORE OR LESS THE POSITION WE ARE IN NOW".Some five minutes later the instructor reported that the aircraftwas climbing through 4,000 feet on the QNH and that the base heightfor the spinning exercise would be 3,000 feet. ATC replied withtraffic information and the instructor's acknowledgement was thelast coherent transmission received from the aircraft.

At about 1240 hrs a witness being driven in a car near Southportbeach saw a white coloured aircraft spinning - she thought tothe right - through several rotations before it hit the water,still spinning. From the beach the witness and her husband couldsee a white coloured object floating in the water but they wereunsure whether this was the same object they had seen spinning.Because model aircraft are often flown from the beach, there hadbeen no smoke and no visible markings, and there were other peopleon the beach who were apparently uninterested in the floatingobject, they concluded that the object was a model aircraft. Itwas not until later when she saw a news report of the crash thatshe reported her sighting to the police.

Radar data analysis

Recorded radar data for the last few minutes of flight were obtainedand analysed by the AAIB. The early data points showed the aircraftcircling to the west of Southport at an airspeed of about 82 ktwhich is consistent with the normal climb speed of 83 mph. Theaircraft's transponder altitude code was corrupted and it wasnot possible to determine accurately the aircraft's vertical profile.Nevertheless, by correlating the data with the commander's altitudereports it was deduced that the aircraft climbed at a rate ofabout 400 ft per minute from 2000 feet altitude for up to 13 minutesgiving a probable spin entry altitude of at least 6,000 feet.At 12:36:56 hrs the aircraft entered a manoeuvre consistent witha spin or spiral dive and the final radar return was recorded62 seconds later. At about this time the Warton Approach controlleralso noticed the aircraft enter a manoeuvre which rendered theaircraft almost stationary on the display, a manoeuvre he knewto be consistent with a spin.

At 12:38:08 hrs (10 seconds after the final radar return) an unusualsound was recorded on the Warton Approach Frequency. Spectralanalysis of the sound indicated that it was a complex sound ofabout 2.5 kHz pitch and 2 seconds duration which was most probablytransmitted from the accident aircraft.

Search and Rescue

Although the aircraft was receiving only a Flight InformationService from Warton Approach, the Controller soon realised thatthe aircraft had disappeared from his radar display. He attemptedto contact the aircraft by RTF at 1243 hrs but there was no replyso at 1247 hrs he asked another aircraft on his frequency to searchthe area where he had last seen the aircraft (which was closeto the position where the aircraft was eventually found). Thisaircraft saw no sign of wreckage on the surface. The controllerthen instigated a check with local airfields which proved negative.The Lancashire Police Force Helicopter joined in the search atabout 1300 hrs and was vectored to the area where the aircrafthad last been seen but there was no sign of the PA28. Anotherhelicopter from Blackpool joined the search and later still twoRAF Search and Rescue helicopters joined in; during this processthe sea search area was expanded to the north and south of Warton'sextended

Runway 26 centreline. One RAF aircraft detected an EmergencyLocator Beacon (ELB) with its specialised equipment and homedto the signal. The beacon was traced to the vicinity of BlackpoolAirport. Surface-based assets including elements of the Coastguardand the Sefton District Council rescue services also joined thesearch.

The sea bed at Southport is sandy and shelves very gently leavinga beach about two miles wide at low water. Tidal currents disturband carry the fine sand leaving the water brown and turbid inappearance.

On the day there were spring tides with a range of 25.6 feet betweenhigh and low water. High water occurred at 0925 hrs and low waterat 1600 hrs. When the aircraft crashed into the sea the tide wasebbing and it would reduce by another 12 feet before low water.At 1440 hrs the wreckage was sighted by the lifeboat when themainwheels were seen protruding from the water; at this stagethe water was about five feet deep. The wreckage was less thanone quarter of a mile from the last recorded radar position.

Wreckage Recovery

Aerial photographs taken before the occupants were recovered showedsand being swept along beside the wreckage and the vertical visibilitythrough the water was less than one foot. At this stage the aircraftwas inverted and the visible portions of the underside of thefuselage, wings and stabilator appeared intact. Consequently,it is unlikely that any significant debris was liberated fromthe aircraft during water impact. Moreover, any floating debriswould have been carried away by the tidal currents and the sunkenwreckage would have been invisible until the water depth reducedfrom the entry depth of about 17 feet to 6 feet or less. It isnot known for how long the aircraft floated but its proximityto the final radar position indicates that it could not have floatedfor very long.

To right the aircraft the lifeboat crew attached a strong ropeto one of the main gear legs and towed it diagonally so as topivot the aircraft around its tail and wing tip which probablydug into the sea bed. This tactic was successful but the aircraftstructure was disrupted in the process. The occupants were cutfree from their harnesses and recovered to the shore. Later apost-mortem revealed that neither occupant suffered from any medicalcondition which was likely to have contributed to any pre-impactincapacitation. However, the impact injuries probably concussedthe instructor and incapacitated the trainee.

An attempt was made to recover the wreckage on the day followingthe accident but the effort was hampered by the very brief 'window'available at low tide to enable suitable vehicles to be deployed.Lying in a minimum of about five feet of water at low tide, itbecame apparent that even more damage had been inflicted on theaircraft due to wave action such that the fuselage was completelydisrupted and the vertical fin and rudder could just be discernedfolded against the left wing trailing edge.

The first recovery attempt failed but major portions of the aircraftwere subsequently recovered by the local lifeboat crew a few dayslater. These comprised the engine, propeller and firewall, wingsand cabin floor, the lower half of the rear fuselage and the stabilator.The fin, rudder, instrument panel and majority of the fuselagewere not recovered.

Examination of the Wreckage

Although a substantial amount of the wreckage was missing, muchof the flying control runs were present apart from the controlyokes and mechanism behind the missing instrument panel. It waspossible to determine that the rudder and stabilator cables hadnot suffered any pre-impact disconnection. The stabilator trimcable drum was found to be on the fully nose-up stop, almost certainlydue to differential pulling on the cables as the aircraft brokeup. As found, the flap lever was in the first extended detent,which should clearly not be the case given the nature of the pilots'intentions. However, the flap mechanism was still free to articulateand it was possible to move the flap lever from UP towards theextended positions with virtually normal action. Thus there wasno way to determine conclusively whether the flap lever had beenmoved during or after impact as no witness marks were found onthe flap surfaces themselves which could indicate a particularpre-impact position.

The two front seats were recovered, one still attached to oneof its rails. The locating pin was found in the extreme forwarddetent with no signs of having broken-out of any other position.It is difficult to accept that this was a pre-impact locationof the seat as it would be difficult for anyone of average buildto operate the aircraft in such a cramped seating position. Hadthe seat inadvertently moved forward during the aircraft's manoeuvring,then the occupant would have been restrained by his seat harness.In the case of the other seat, which was found separate from itsrails, it was not possible to ascertain which position it hadbeen in, neither was it possible to determine which (left or right)location either seat had occupied in the aircraft.

In summary, the examination of the wreckage available did notreveal any obvious reason for the aircraft's failure to recoverfrom the intentional spin. The general condition of the structure,particularly as evident from the aerial photographs before majordisruption occurred, was consistent with entry into the waterin a relatively flat, upright, attitude and moderate rate of descentwith almost no forward speed. The condition of the propeller alsosuggested that little, if any, engine power was present.

G-BBLA's Spin Behaviour

The aircraft was acquired in 1978 by the previous owners of theflying club. The CFI at the time, who remained in post until 1985,informed the AAIB that from the time the aircraft was acquired,compared with two other PA28-140 aircraft belonging to the club,G-BBLA had always exhibited a tendency to spin with an unusuallynose-up pitch attitude. No reason for this idiosyncratic behaviourwas identified and the club preferred to use other aircraft forspin training.

The commander and the club's deputy chief engineer (who held aPPL) were also aware of G-BBLA's unusual spin characteristicsbut the aircraft had not previously showed any extreme reluctanceto recover from a spin. However, a few days before the accidentthe commander told the deputy chief engineer that he had attemptedto enter a spin but the aircraft would not **enter** a spinin either direction. The engineer offered to investigate thisproblem but the commander decided that it was unnecessary.

In his personal folder for briefing students, the commander hadnotes on spinning technique which for spin entry recommended closingthe throttle as if practising a stall and then applying full rudderand easing the stick fully back at a speed of 60 to 65 mph. Aphotocopy of this page was found on a desk in the club's classroom;the original speeds had been amended by hand to read 65 to 70mph. There was only one student at the club who was undergoingspin training at the time and so it seems likely that the commanderbriefed the student that they would attempt to induce the aircraftto spin by raising the entry speed.

According to the club records and his own logbook, before theaccident spin the commander had not spun G-BBLA since its Certificateof Airworthiness Flight Test, flown by him, reportedly on 10 September1995. During this test he recorded 'SATIS'in the check boxes labelled 'Any abnormalityof spin or recovery' during spins in both directions andthe aircraft recovered after one and half turns.

Although he had not practised spinning in the PA28-140 since September1995, the commander had practised spinning a Chipmunk as recentlyas 15 August 1996. He was unable to spin the club Chipmunk after15 August because the club sold it on that day leaving it withonly PA28-140 aircraft in which to practice spinning. The spinrecovery technique in the commander's briefing notes followedthe procedure common to most light aircraft types. Essentiallythe technique was: check throttle closed; full opposite rudder;pause; ease stick forward until spin stops and then centralisethe controls before easing out of the ensuing dive.

Spinning the PA28-140

The Manufacturer's Flight Manual for G-BBLA dated 27 April 1973stated that the aircraft may be intentionally spun provided thatthe weight and balance are within permitted limits.

The two pages in the Flight Manual allocated to 'Handling' madeno mention of spin entry or recovery techniques. In 1982 the PiperAircraft Corporation issued Service Bulletin (SB) No 753whose purpose was as follows (quoted verbatim):

To provide expanded spin recovery procedures to assurethat proper safety practices and procedures relative to utilitycategory flight operations are in effect. Spin training is permittedonly in the utility category.

Accompanying this Service Bulletin is an expandedinformation placard to be installed in the cockpit in full viewof the pilot. This Service Bulletin is to be retained at all timesin the airplane with the aircraft paperwork.

There was no record of embodiment of this SB in the G-BBLA's logbooks.The SB re-iterated the utility category weight and balance limitations,described the need to take account of individual seat positionson the seat tracks, and itemised the manufacturer's recommendedspin recovery technique. In this technique the handling of thecontrol column in pitch was materially different to that containedin the commander's notes. The SB stated the procedure as follows:

1. Apply and maintain full rudder opposite the directionof rotation.

2. As the rudder hits the stop, rapidly move thecontrol wheel full forward and be ready to relax the forward pressurewhen the spin rotation has stopped.

3. As rotation stops, neutralize the rudder and smoothlyrecover from this dive.

Notes within the SB included the following statements:

In all spin recoveries the control column shouldbe moved full forward briskly. This is vitally important becausethe steep spin attitude may inhibit pilots from moving the controlcolumn forward positively.

Delay in moving the control wheel forward may resultin the aircraft suddenly entering a very fast, steep spin modewhich could disorient a pilot. Recovery will be achieved by brisklymoving the control wheel fully forward and holding it there whilemaintaining full recovery rudder.

Aircraft weight and balance

Being unaware of the refined limits in SB753, the commander shouldhave assessed the aircraft's weight and balance relative to theFlight Manual data which specified a nominal seat position of85.5 inches aft of datum. Calculations made following the accidentsuggested that, using the aircraft's weight and centre of gravityschedule dated 3 September 1992; the limits in the Flight Manual;the estimated fuel load of 8.3 Imperial gallons; and with theseats in their nominal positions, the centre of gravity wouldhave been 0.5 inches forward of the forward limit for aerobaticsat the time of the accident.

The AAIB then obtained accurate weights and leg lengths for bothpilots and assessed the likely seat positions they would haveadopted before practising spinning. These data were then usedto re-calculate the CG position using the seat position momentarms contained in SB753. The calculations showed that the CG duringthe spin was probably 0.2 inches forward of the forward limit.

The New Piper Aircraft company were asked if they could provideany likely reasons why the aircraft might be reluctant to recoverfrom a spin. Their suggestions were helpful but not applicableto GBBLA.

Safety recommendations

During the investigation it transpired that few PA28-140 operatorsused the type for spin training but many were unaware of the contentsof SB753. Therefore it was recommended that:

97-5 The CAA should bring to the attention of UK ownersand operators of the PA28-140 the existence and content of PiperService Bulletin No 753.

97-6 The CAA should make mandatory any manufacturer's ServiceBulletin which addresses important aspects of aircraft flyingqualities or handling techniques.

97-7 The FAA should require the Piper Aircraft Companyto re-issue the content of Service Bulletin 753 as an officialsupplement to the PA28-140 Flight Manual.