AAIB Bulletin No: 9/95 **Ref: EW/C95/4/4** **Category: 1.3**

Aircraft Type and Registration:	Piper PA-28-181 Cherokee Archer II, G-BOZT
No & Type of Engines:	1 Lycoming O-360-A4M piston engine
Year of Manufacture:	1977
Date & Time (UTC):	29 April 1995 at 1326 hrs
Location:	North Sea, 30 nm east of Clacton, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - Fatal Passengers - N/A
Nature of Damage:	Aircraft missing
Commander's Licence:	Private Pilot's Licence with IMC Rating
Commander's Age:	47 years
Commander's Flying Experience:	538 hours (of which 446 were on type) Last 90 days - 11 hours Last 28 days - 2 hours
Information Source:	AAIB Field Investigation

History of the Flight

The pilot arrived at Derby Airfield at approximately 1100 hrs on Saturday 29 April 1995 for a solo pleasure flight to Wevelgem in Belgium. His flight planning had been carried out, before he left home, using the self-briefing telephone 'FAX' services. On arrival he was met by an engineer from the Derby Aero Club who had earlier refuelled the aircraft, G-BOZT ('ZT'), to the full tank capacity of 40 gall imp. This gave the aircraft an endurance of 5.4 hours flying at the planned cruising speed of 105 kt (consumption rate 7 gall imp per hour; 2 gall imp of fuel unusable).

Before departure the pilot was seen to don a lifejacket with a radio distress beacon attached to the belt. He was also seen to stow a liferaft in the baggage area, which is formed by the cabin floor behind the rear seats. The aircraft departed Derby at 1143 hrs.

At 1146 hrs the pilot made radio contact with East Midlands Approach on frequency 119.65 MHz transmitting that he was "JUST AIRBORNE FROM DERBY, 10 NM SOUTH OF TRENT APPROACHING LICHFIELD...MAINTAINING 1,500 FEET". One minute later East Midlands radar identified the aircraft

3 nm north east of Tatenhill. The East Midlands controller also told the pilot that he had sent a departure message thus activating his flight plan. At 1153 hrs, having been radar identified by Birmingham Approach, the pilot was transferred to their frequency of 118.05 MHz. The Birmingham approach controller advised him that the aircraft was under a flight information service at 1,500 feet. At 1157 hrs the aircraft climbed to 2,000 feet. Four minutes later the pilot reported that he was climbing to 2,500 feet and changing frequency to Leicester Radio on 122.125 MHz.

The flight continued routinely and at 1227 hrs the pilot contacted London Information on 124.6 MHz stating that he was 2 nm north of Alconbury at FL050 heading 110° to route via 52°N 001°30'E, which he estimated at 1307 hrs, and the reporting point of 'COSTA', which he estimated at 1354 hrs. The London Information controller replied that there was no traffic to affect his flight. As the aircraft approached Ipswich the pilot left the London frequency momentarily to call Ipswich Radio on 118.325 MHz to enquire about parachuting activity in the area. Having been advised that the area was active he remained well clear of the airfield overhead. At 1300 hrs he reported back on the London Information frequency. The pilot transmitted crossing the coast at position 52°N 001°30'E at 1305 hrs.

At 1319 hrs the pilot transmitted "MAYDAY MAYDAY MAYDAY THIS IS G-BOZT WITH ENGINE FAILURE". The London Information controller does not provide aircraft with a radar service so he therefore asked the pilot for the aircraft's position. The pilot replied "I'M ON THE 100° RADIAL FROM CLACTON, I DON'T HAVE DME[1], BUT I ESTIMATE ABOUT 25 DME.....I'VE TURNED BACK TO THE COAST TOWARDS CLACTON". The controller told the pilot to select code 7700 on his transponder and contact London Military on the international distress frequency of 121.5 MHz. No reply was received from the pilot. The controller tried a further four times to contact the pilot but without success.

The pilot of another aircraft (G-BEZP), listening on the frequency, also tried to contact the pilot of 'ZT' without success. At 1325 hrs the crew of a Boeing 737, operating a scheduled airline service from Munich to Birmingham also tried to contact the pilot and advise him to change frequency to 121.5 MHz. Their attempt was eventually successful but the pilot replied that he 'did not have time as the water was getting closer'. He did however say that he had a radio distress beacon on board. The airline crew replied that the rescue helicopters had been notified and that they were on their way. Moments later the Boeing crew, who were also monitoring the international distress frequency, heard a very brief transmission from a distress beacon.

At 1334 hrs another airline crew, inbound to Heathrow, were asked by London Control if they could listen out on the distress frequency, descend and orbit the area where they estimated that the pilot may have ditched. Because of their low fuel state the crew could only remain at low level in the area for

[1] Distance Measuring Equipment

approximately seven minutes. They did not receive any voice or distress beacon transmissions on 121.5 MHz but at 1338 hrs, however, they did sight an unidentifiable white object in the sea.
At 1348 hrs a private pilot, in aircraft registration G-BEZH, was asked to search the position of the 'white object'. The pilot later reported that he had sighted a white passenger ferry, from his search height of 2,000 feet, but the conditions were quite misty. He continued to the search area and acted as a relay between the London controller and the rescue helicopter en route to the scene from RAF Wattisham. After 40 minutes he had to depart the area, landing at Southend to refuel.

Meteorology

An aftercast supplied by the Meteorological Office at Bracknell described the synoptic weather situation on that day as a ridge of high pressure extending southwards across the North Sea maintaining a northeasterly surface airflow over the area. More specifically it described the weather conditions in the southern North Sea area by Clacton as visibility of approximately 6 km; scattered or occasional broken cloud at 3,500 to 4,500 feet with broken cloud at a base of 8,000 to 10,000 feet; surface wind 080°/15 kt with a temperature of +10°C; relative humidity 67% and a mean sea level pressure of 1016 mbs. The sea temperature was +9°C. Maritime Rescue Sub-Centre (MRSC) Thames recorded the surface conditions in their situation report as wind 050°/10 kt, sea state 2, swell state 1 with a visibility of 6 nm.

Pathology

A pathological examination of the pilot's body revealed that he had evacuated the aircraft unscathed, except for a small abrasion to the right shin, but died from drowning with hypothermia probably playing a part due to the lack of protective clothing.

Search and Rescue

The pilot transmitted his "MAYDAY" call at 1319 hrs. A Sea King rescue helicopter, of No 22 Squadron RAF Wattisham in Suffolk, was scrambled at 1325 hrs to search for the pilot and was airborne ten minutes later. Initially the helicopter crew was instructed by the Distress and Diversion (D & D) controller at the London Air Traffic Control Centre (LATCC) to carry out a search based on the position of the reported 'white object' sighted by the commercial airline crew as this was close to the aircraft's Last Known Position (LKP). On reaching that position the helicopter crew carried out a cloverleaf search pattern out to 1.5 nm using "body in water" (BIW) track spacing. Eventually with nothing sighted the helicopter repositioned to a datum set on the 100° radial from Clacton at a range of 30 nm.

At 1350 hrs they were in position and again searched in a cloverleaf pattern with BIW track spacing and then continued with an expanding square search out to 5 nm from the datum using 1 nm track spacing at 200 feet. At 1530 hrs with nothing sighted the crew commenced a Creeping Line Ahead (CLA) search from the square on a 280°M mean track, 2.5 nm either side of track, with 1 nm track spacing at 300 feet. After 14 nm down this bearing the crew stepped north to account for tidal drift and at 1630 hrs returned to base to refuel.

Meanwhile the D & D at West Drayton checked Suffolk and Essex airfields to cover the possibility that the aircraft had continued to the coast. Maritime Rescue Sub-Centre (MRSC) Thames alerted shipping in the area and co-ordinated a search of the coastline and inshore areas, biased towards the LKP, by the Walton and Harwich lifeboats, the Clacton and Harwich inshore lifeboats and a Coast Guard launch. The Essex police helicopter searched the disused airfields at Bentwaters and Woodbridge and then the coastline from Harwich to Southend.

After refuelling, the RAF helicopter resumed the search. At 1935 hrs, due to darkness the helicopter returned to land.

Overnight, the Rescue Co-ordination Centre (RCC) at Plymouth, with assistance from the RCC at Edinburgh, used radar replay data to calculate a search datum for the following morning. The data indicated a final aircraft track of 300° and the assumption was made that when contact was lost with the aircraft at 2,000 feet it had glided, losing 500 feet per minute at a ground speed of approximately 80 kt, before ditching. The calculated impact point was used to compute two new search areas based firstly on "wreckage/man in the water" (MIW) and secondly assuming that the pilot had boarded a liferaft. The two areas overlapped to a large extent.

At 0655 hrs the following day the rescue helicopter departed Wattisham and commenced a CLA search of the MIW area in ideal weather conditions. The crew located the body of the pilot at 0825 hrs, some 19 hours after the ditching, in a position which was in the south east quadrant of the wreckage/MIW search area. The helicopter crew stated that the weather conditions on the second day were "perfect" and thus it was much easier to spot objects in the water than the previous day. No radio distress beacon transmissions were detected at any time by any search unit.

The pilot was found floating face up in the water in a fully inflated lifejacket. The sea was calm but waves were seen by the helicopter rescue crew to be breaking over the pilot's face. The water-activated light (McMurdo Light) attached to the lifejacket was not functioning. He was wearing trainers, jeans and a denim shirt and had no immersion protection or liferaft. A radio distress beacon was found to be floating underwater attached to the lifejacket belt.

Aircraft

The aircraft was constructed in the USA in 1977 and imported to the UK in 1988, having accumulated 3,208 flying hours. Following initial inspection for the granting of a UK Certificate of Airworthiness in the Public Transport category it had been maintained by one maintenance organisation. It had been used by the company that owned it and by a flying club on a rental basis. Maintenance records indicated that at the time of the accident 1,148 flying hours had been accumulated since UK registration, for a total of 4,355 flying hours since new, and that the engine had operated for 970 flying hours since complete overhaul in 1989. The records indicated that the aircraft and its engine had been maintained in accordance with the CAA Light Aircraft Maintenance Schedule - Fixed Wing (CAA/LAMS/FW/1978 Issue 2). The radio equipment installed included twin VHF (Very High Frequency) communication radios; a navigation installation consisting of twin VOR (VHF Omnirange), DME (Distance Measuring Equipment) and ADF (Aerial Direction Finding); and an ATC (Air Traffic Control) radar transponder.

Examination of Aircraft and Engine Log Books and information from the maintenance organisation revealed no evidence to suggest that G-BOZT had not been serviceable at departure on the accident flight and indicated that the aircraft had experienced a relatively low rate of reported serviceability problems. Information from pilots who had previously flown the aircraft indicated that mutual interference between the DME and the transponder had been experienced in the weeks prior to the accident, at times causing intermittent DME indications and corruption of the squawk code received by ground radar. With these possible exceptions, the evidence indicated that the aircraft had not suffered a history of problems that could have been relevant to the accident. With no parts of the aircraft having been recovered, an assessment of the cause of the loss of engine power that led to the ditching could not be made.

Survival Considerations

The CAA publishes specifications for survival equipment such as lifejackets and liferafts but does not require any such equipment to be carried for private flying. G-BOZT's pilot was carrying relatively extensive equipment for post-ditching survival.

Liferaft

The pilot owned his own liferaft, a Beaufort Ltd 4 person Air-Pac type, which he had reportedly had regularly serviced. It was coloured bright yellow and orange and contained a survival pack which included pyrotechnic signals and a sea marker dye. It was contained in a soft valise measuring 24 x 12 x 5 inches; the published stowed weight was 10.5 kg (23 lb). In order to reduce size and

weight it was not designed to fully meet CAA specifications; such a liferaft typically would be around twice the size and over twice the weight of the above. The pilot was seen before departure to stow a liferaft in the baggage area, accessible from inside by reaching over the backs of the seats or externally via the baggage door on the right side of the fuselage.

The liferaft was not recovered and it is possible that the pilot did not manage to remove it after the ditching and that it sank with the aircraft. A liferaft can be considered too bulky to stow on the front right-hand seat next to the pilot, particularly on aircraft types with a forward door on the right side only. On many light aircraft a liferaft typically would be stowed behind the front seats, either on the floor between front and rear seats, on the rear seats or behind the rear seats on the floor forming the baggage compartment and would commonly be strapped down. The RAF School of Aviation Medicine has noted that extricating such an item from a sinking aircraft is likely to prove difficult, particularly if the pilot is the sole occupant, unless it is carried on the front seat. Use of a liferaft is likely to provide major enhancement of survival prospects compared to the subject being immersed, due both to the much more favourable environment and to the greatly improved conspicuity.

Lifejacket

The pilot's lifejacket was an RFD Ltd Type 102 Mk 2BA manufactured in 1989, designed to be worn over the head and fastened with a tape belt tied around the waist. It was bright yellow. It was inflatable by manual actuation of a carbon dioxide bottle to provide a reported buoyancy of 35 lb and incorporated an oral inflation tube, a whistle and a water-activated light. The latter was required to provide a 1 lumen white light for at least 12 hours; a test on a similar unit found that useful illumination was given for 18 hours.

On receipt of the lifejacket for AAIB examination the belt remained tied, having been released by cutting near its attachment to the jacket. The tied length appeared to correspond to two turns of the belt around the waist and the tie comprised a tight granny knot on the right side. The lifejacket was also examined by the RAF School of Aviation Medicine and pool tests were conducted with a subject wearing another jacket of the same model to assess its characteristics. No evidence was found to suggest that the pilot's lifejacket would not have satisfactorily supported him. It was noted that it was not provided with a spray hood and face seal to prevent water from splashing onto the face and the RAF School of Aviation Medicine considered that this had contributed to the cause of death.

Radio Distress Beacon

The radio distress beacon was a Locat Developments Ltd Type LOCAT LDT 26 manufactured in 1989. It is of a type in widespread use, with reportedly around 10,000 sold, although no longer manufactured. The unit is intended to transmit a signal on the distress frequencies of 121.5 MHz and 243 MHz after having been activated manually by pulling a tag to break a safety seal and extract a pin, for approximately 36 hours. It comprises a rectangular plastic box (5 x 2.4 x 1.8 inches) containing a lithium battery and transmitter electronic circuits connected to a 4.3 inch long external stub aerial. The casing is made up of two mouldings heat-welded together and penetrated by two holes, each formed by the conjunction of a semi-circular cut-out in each casing half. One hole, in the base, is sealed by a transparency cemented to the casing to provide a window for viewing a transmitter output indicator light. The other hole accepts the base of the aerial, with an elastomeric ring forming a seal. An attachment lug is incorporated in the casing near to the aerial base.

An instruction sheet for the beacon stated that the battery cells would maintain 80% of their capacity after 7 years storage at 25°C. It indicated the 'known range' versus receiver height as:

200 nm range for	37,000 ft receiver height
18 nm range for	1,000 ft receiver height
5 nm range for	Receiver at sea level

It also noted that:

The Locat beacon will float - BUT NOT UPRIGHT

and instructed "Hold beacon upright or suspend vertically [in liferaft] to transmit".

As received for AAIB examination, the seal had been broken and the activating pin extracted. A lanyard was found looped through the attachment lug, comprising an 8 inch length of 0.1 inch diameter cord fastened with a reef knot. The configuration was consistent with the lifejacket belt having been passed through the loop of the beacon lanyard before being tied; this would have restrained the beacon to within approximately 3.5 inches of the belt. The beacon was also examined by the RAF School of Aviation Medicine with the assistance of the company that had bought the original manufacturer in 1993. Pool testing showed that when restrained only by the lanyard the unit floated with the aerial pointing downwards at around 45°, with the aerial thus completely underwater. It was noted that with the lanyard connected to the lifejacket belt and the lifejacket wearer in the water it would barely be possible to hold the beacon with its aerial tip above the water surface. It was reported that no useful transmissions would be available to rescuers unless the aerial were above the surface and pointing upwards.

Internal inspection of the beacon revealed a quantity of brown/grey sludge, that appeared to comprise a mixture of seawater and battery electrolyte, together with extensive corrosion of the electronic components. Examination indicated that the most likely path for water ingress was via the casing/aerial base seal; any misalignment between the semi-circular cut-outs in the casing would compromise the integrity of the sealing arrangement. The quantity of sludge did not appear sufficient to significantly effect the beacon floatation characteristics.

Clothing

Information from the RAF School of Aviation Medicine indicated that experience and research has shown that the expected survival time for a normal lightly-clothed person in water at 9°C would be in the order of 1 hour, following progressive loss of consciousness due to hypothermia. It is noted that a number of relatively inexpensive immersion suits are available that dramatically increase the expected survival period in the water by providing thermal insulation. These include inflatable suits, with low insulation properties when uninflated, that effectively constitute a personal, insulated liferaft and reportedly increase survival time by many times.

Search and Survival Aspects Summary

The pilot was a fit, confident and competent aviator who managed to ditch virtually without injury in benign weather conditions reasonably close to land and had made preparations for post-ditching survival that were probably above average, including the carriage of relatively extensive sea-survival equipment.

However, it is recognised that a liferaft, unless carried on the front seat, is likely to prove difficult to extract from an aircraft that may be sinking rapidly, and the evidence indicates that it had not been possible in this case. The lifejacket appeared to have carried out its primary function of maintaining the pilot upright in the water with his face clear of the surface but the absence of a spray hood and face seal could have contributed to the cause of death once consciousness was lost. While the lifejacket improved the pilot's conspicuity to some extent, it was a small visual target compared to a deployed liferaft, which in this case also contained means of actively attracting attention. Datuming of the search area appeared to have been hampered by definite confirmation that the aircraft had ditched, by an absence of radar emergency transponder returns and possibly by delay in identifying the aircraft's flight path from radar recordings. Only a brief radio distress beacon transmission was received and the evidence indicated that the attachment lanyard would have prevented the beacon from being positioned

with the aerial above surface, that even without the lanyard restraint the beacon floatation characteristics were such that the aerial would not have remained pointing upwards unless held by the pilot and that water leakage may anyway have severely limited the time for which the unit would have transmitted.

Without this signal to home in on, with no wreckage or liferaft to assist the search and with the difficulties in datuming the search area, the search by the rescue agencies was severely hampered. The pilot's survival time with the lightweight clothing worn was in the order of 1 hour.

Safety Recommendation 95-18

This accident emphasises the hazardous nature of a ditching, even when comparatively well prepared. Rapid location and rescue cannot be guaranteed and the importance of effective survival clothing and equipment is paramount. Therefore the following safety recommendation has been made to the CAA:

The CAA should publish detailed advice, aimed at pilots of single engined aircraft operating over water, on:

- The fundamental principles of sea survival.
- The operating principles of the Distress and Diversion cell at LATCC.
- Search and rescue techniques employed during and after an emergency situation.
- The potential benefits of a lifejacket spray hood and face seal.
- Liferaft carriage and deployment considerations.
- Aspects of radio distress beacon transmitters requiring consideration.
- The benefits of immersion suits on survivability.