AIRCRAFT ACCIDENT REPORT 7/81

DEPARTMENT OF TRADE

# Report on the accident to Piper PA31 Navajo G-LCCO at Earl Stonham, Stowmarket, Suffolk, on 20 August 1980

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**Department of Trade**
**Accidents Investigation Branch**
**Kingsgate House**
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7 August 1981

*The Rt Honourable John Biffen MP*
*Secretary of State for Trade*

Sir

I have the honour to submit the report by Mr C C Allen, an Inspector of Accidents, on the circumstances of the accident to a Piper PA31 Navajo G–LCCO which occurred at Earl Stonham, Stowmarket, Suffolk, on 20 August 1980.

I have the honour to be
Sir
Your obedient Servant

W H Tench
*Chief Inspector of Accidents*

Accidents Investigation Branch

**Aircraft Accident Report No 7/81**
**(EW/C 713)**

| | | |
|---|---|---|
| *Registered Owner and Operator:* | | Group Lotus Limited, Norwich |
| *Aircraft:* | *Type:* | Piper PA31 Navajo |
| | *Model:* | 325 C/R |
| | *Nationality:* | British |
| | *Registration:* | G–LCCO |
| *Place of Accident:* | | Earl Stonham, Stowmarket, Suffolk<br>Latitude: 52° 11′ North<br>Longitude: 001° 05′ East |
| *Date and Time:* | | 20 August 1980 at approximately 1630 hrs<br><br>All times in this report are GMT |

# Synopsis

The aircraft was returning from Stapleford Tawney aerodrome, where it had just been serviced, to its base at Hethel aerodrome, near Norwich.

When under the surveillance of Honington Radar, the pilot requested and was granted permission to manoeuvre between flight level (FL)75 and FL60. A few minutes later the aircraft was observed on radar to be flying in a south-easterly direction and shortly thereafter to disappear from the radar picture. At about this time the aircraft was heard to be in a high speed descent and was seen to break up at about 2,500 feet. The main portion of the wreckage burst into flames shortly after impact and the pilot, who was the only occupant, was killed.

It is concluded that the accident was caused by the pilot attempting to recover from a dive whilst flying at a speed considerably in excess of the aircraft's permitted maximum. The excessive speed resulted from his loss of control of the aircraft, most probably following an attempt to perform a prohibited aerobatic manoeuvre.

# 1. Factual Information

## 1.1 History of the flight

The aircraft had just undergone a one hundred hour check and a flap track modification at Stapleford Tawney. The accident occurred whilst it was being returned, by the Aircraft Operations Manager of Group Lotus Ltd, to its base at Hethel, near Norwich.

At Stapleford Tawney, it was this pilot's custom to carry out a low level flypast opposite the servicing hangar, apparently to indicate to the engineers that all was well with the aircraft. Having taken off at approximately 1603 hrs, the pilot executed this manoeuvre and departed, in a climbing turn, *en route* for Hethel at about 1607 hrs.

The flight proceeded, apparently without incident until, at 1618 hrs, the pilot informed Honington Radar that he was heading 035° magnetic, with his transponder set to the code 'A 4321', and that he was just climbing through FL60 for FL 75 with about 38 nm to run to Hethel. He was given a new transponder code 'A 1031' and told to report level at FL75, which he subsequently did.

A little later, at 1624 hrs, the pilot requested permission to manoeuvre between his present level and FL60, a height band of 1,500 feet. He was informed that he was cleared to do this but subsequently, at 1629 hrs, was told that he was a little close to Wattisham RAF station and was asked to manoeuvre to the north. He acknowledged this call but, at 1631 hrs, when the Honington controller asked him to confirm that he was taking up a northerly heading, he did not reply. No further communication was received from the aircraft.

At approximately 1630 hrs, the aircraft was seen from the ground to be pulling out of a steep dive into nearly straight and level flight, with both engines making a very high-pitched note. About a second later, the aircraft was observed to break up at an estimated height of about 2,500 feet, an event which left a main wreckage trail 2½ kilometres long. The forward fuselage, with the right inner wing attached, fell to the ground adjacent to the main road through Earl Stonham and, a few seconds later, burst into an intense fire which destroyed the instruments, radios and controls. The pilot was killed on impact.

## 1.2 Injuries to persons

| *Injuries* | *Crew* | *Passengers* | *Others* |
|---|---|---|---|
| Fatal | 1 | – | – |
| Non fatal | – | – | – |
| Minor/none | – | – | |

## 1.3 Damage to aircraft

The aircraft was destroyed by the combined effects of break-up in the air and the subsequent post-impact fire.

## 1.4 Other damage

A considerable area of crops, a wooden fence and a tree were damaged by the fire and the main impact.

## 1.5 Personnel information

| | |
|---|---|
| *Commander:* | Male, age 26 years and 8 months |
| Licence: | Private Pilot's Licence (PPL); valid permanently |
| Most recent certificate of test: | 1 June 1979 |
| Most recent certificate of experience: | 23 March 1980, valid for 12 months |
| Ratings: | Groups A, B and motor gliders<br>Night and IMC ratings |
| Last medical examination: | 21 May 1979, valid until 21 May 1981 |
| Flying experience: | 822 hours, of which approximately 230 hours were on type. There is evidence that the pilot had received basic training in aerobatic flying. |

The pilot joined Group Lotus Ltd in June 1979, with a PPL and 204 hours flying experience. He was engaged as Aircraft Operations Manager, which included general responsibility for the company's aircraft and all documentation relating to their operation. Apart from his basic salary, he was to be paid an additional amount 'when travelling in the company aircraft'. During the last year he had averaged 46 hours per month as a pilot and it was agreed that his contract would be terminated should his pilot's licence be withdrawn.

## 1.6 Aircraft information

### *1.6.1 General information*

| | |
|---|---|
| Manufacturer: | Piper Aircraft Corporation |
| Aircraft type: | PA 31 (Navajo) Series 325 C/R |
| Date of Manufacture: | 1978 |
| Certificate of Airworthiness: | Renewed October 1979, valid until October 1980 |

| | |
|---|---|
| Certificate of Registration: | Issued August 1978 |
| Total airframe hours: | 497 |
| Engine type: | Lycoming T10–540 – F2BD |
| Total engine hours: | 497, with no record of defect |
| Fuel type: | 100/130 octane |
| Maximum weight authorised: | 6,500 lbs |
| Weight at the time of the accident: | 5,410 lbs, assuming fuel contents of 550 lbs (about half full) |
| Centre of gravity limits: | 124.2 to 138.0 ins aft of zero datum |
| Centre of gravity: | 126.99 ins aft of zero datum |
| Additional information: | (i) The aircraft had been maintained in accordance with an approved maintenance schedule.<br>(ii) Aerobatics are specifically prohibited by the Flight Manual, which constitutes part of the Certificate of Airworthiness.<br>(iii) The fuel system was not capable of sustaining flow under conditions of negative 'g'. |

*1.6.2* *Past defect history*

During the manufacturer's flight test programme, carried out in 1978, this aircraft was reported as displaying instability in the pitching plane. Full rectification was carried out and there is no record of any recurrence of the problem.

The technical log shows that a series of autopilot defects had been entered at various times during the last year. All these faults had been rectified except for the final entry, dated 12.8.80, which reads 'Autopilot dutch rolls'. In clearing this entry, the engineer wrote 'No fault found, suspect wrong button used'.

A modification, as defined in Piper Service Bulletin 647, was carried out during the '100 hour' inspection immediately prior to the accident flight. This modification involved an outboard flap track inspection and re-inforcement.

There is evidence that the aircraft was serviceable prior to departure on the accident flight.

## 1.7 Meteorological information

The weather in the local area was good, with a small amount of cloud and a strong westerly wind. The observation at 1700 hours, made at Wattisham, the closest reporting centre, was:

| | |
|---|---|
| Surface wind: | 250° at 19 kts |
| Visibility: | 20 km |
| Cloud: | 1 okta at 3,000 feet |
| Weather: | Nil |
| Temperature: | 24°C |
| Dew Point: | 17°C |

## 1.8 Aids to navigation

There are a number of ground installation radio aids in the area where the aircraft was manoeuvring, but it was not possible to establish which aids the pilot was using at the time of the accident. The aircraft was under the surveillance of Honington Radar, which does not record radar information; however it was also flying within the coverage of Eastern Radar, which does.

Photographs of the Eastern Radar display were sent to a research establishment for analysis and a reconstruction of the display, with positional times annotated, is shown at Appendix 1 (see also paragraph 1.17.).

## 1.9 Communications

Communications with this aircraft were normal.

## 1.10 Aerodrome and ground facilities

Not relevant.

## 1.11 Flight recorders

None were required and none were fitted.

## 1.12 Wreckage and impact information

### *1.12.1 On-site Examination (see Appendix 2)*

Wreckage was distributed along a line between the villages of Earl Stonham and Stonham Aspal. The main wreckage site, consisting of the fuselage and right-hand stub wing, including the right-hand engine nacelle, was located 300 metres south of Earl Stonham in a small meadow on the west side of the Lords Highway, a minor road running from the village. A post-impact fire, centred on the nose structure and right-hand wing, had completely consumed the fuselage and wing structure.

Both engines were found close together in a corn field some 450 metres southwest of the main wreckage. Both engines had detached at their respective nacelle fire walls and both propellers were feathered. The right-hand engine had been affected by a minor post-impact fire.

The left wing, complete but for 1 metre of outer wing and the tip, was found in a field 200 metres east of the main wreckage site. The wing had separated at the joint in the centre of the fuselage and the mode of failure indicated that wing separation had occurred in down-load. The separated left and right horizontal stabilisers (tailplane) and the vertical stabiliser (fin) were recovered close together some 900 metres east of the main wreckage position. The left outer wing was found some 200 metres further to the east.

The limits of the wreckage trail in an easterly (downwind) direction consisted of a very light structure, personal equipment and paperwork recovered on the outskirts of Stonham Aspel village.

*1.12.2* *Subsequent detailed examination*

The wreckage was taken to the AIB facility at Farnborough where the examination confirmed the evidence found at the accident site and revealed a number of structural features.

A section of leading edge from the detached right outer wing, which had been found early in the wreckage trail, showed clear evidence of a major impact which matched leading edge damage on the right horizontal stabiliser. The latter had failed in a rearwards and downwards direction as a result of this impact.

The vertical stabiliser exhibited a major diagonal bend towards the left-hand side. The bend was not associated with any impact damage but was indicative of a failure induced by air loading. This damage led to the detachment of the vertical stabiliser and the resulting disruption to the rear fuselage caused the separation of the remaining horizontal stabiliser.

Examination of the engine nacelle structure indicated that both engines had detached in an upwards and leftwards direction relative to the airframe. Both engines were strip examined but no evidence of any failure or malfunction was found. Both propellers were in the feathered position when they were recovered, which would automatically follow the loss of fuel supply and propeller control disruption when the engines separated from the aircraft.

Although the fuselage had been totally consumed by the post-impact fire, the flying control cables were recovered. Many overload failures were found in each of the control circuits but all the failures were consistent with the pattern of break-up. The flying control surfaces were also specifically examined for evidence of flutter. None was found.

No evidence was found, as a result of the detailed examination, of any defect that could have either preceded or precipitated the structural break-up.

*1.12.3* *The break-up sequence*

The structural examination indicates that both outer wing sections had failed symmetrically in upload. The right outer wing had detached in upload and struck the right-hand tailplane, structurally disrupting the rear fuselage and, together with air loading, causing the detachment of both horizontal and vertical stabilisers. The resulting 'bunt'[1] caused the left outer wing and the complete inner wing to detach in down-load, and the detachment of both engines at the nacelle fire wall. The evidence suggests that this was a very rapid break-up sequence and there was no evidence to suggest any earlier initiating failure.

No evidence of aerodynamic flutter or engine failure was found, and it is considered that the initial failure of both outer wing sections was consequent upon an up-elevator input, at a speed well in excess of VNE[2].

*1.12.4* *The wreckage trail*

The ground position plot of the major portions of aircraft debris (shown at Appendix 2) allowed trajectory and wind drift plots to be constructed. These plots strongly suggest that the break-up occurred at a height of approximately 2,200 feet and at a speed in excess of 320 knots.

## 1.13 Medical and pathological information

The pilot had been assessed as fit at his last licence medical examination and no evidence of any contributory factor to this accident was found at the post mortem. The pilot's death was caused by multiple injuries and the medical evidence shows it to have occurred before the fire.

## 1.14 Fire

The engines separated from the aircraft and impacted some 450 metres from the main wreckage; the residual fuel therein started a localised fire in the surrounding crops. The main wreckage caught fire a few minutes after ground impact and totally destroyed the forward portion of the fuselage.

The Fire Service appliances arrived on site at 1642 hrs and their four vehicles were positioned on the adjacent road. Having extinguished the two fires, the Fire Service carried out a search for further bodies and the incident was closed at 1710 hrs.

## 1.15 Survival aspects

This accident was not survivable.

At about 1636 hrs, the Police were told that the crash had occurred and were given its exact location. They arrived on site at 1640 hrs and established a 'Major Incident' procedure.

Note 1 A bunt is a manoeuvre involving negative 'g' or pitch-down relative to the aircraft's fore-and-aft axis.

Note 2 VNE is the designed limiting speed which an aircraft must never exceed. VNE for this aircraft is 236 kts indicated airspeed.

## 1.16 Tests and research

Nil.

## 1.17 Additional information

*1.17.1* Amongst the evidence that has come to light, there are two cases of unauthorised manoeuvres having been performed by this pilot. In August 1979, the aircraft was seen flying with one engine feathered, at tree-top height. This flight had not been authorised by the owners of the aircraft. On another and more recent occasion, in a different aircraft, the pilot was flying just above the church spire of a town. A colleague, who was on board at the time, remarked upon this and was told by the pilot that 'this was nothing' and that he had actually 'rolled the Navajo' (G–LCCO).

*1.17.2* Eastern Radar has an aerial which rotates at a rate of 8 revolutions per minute. This produces a radial line on the cathode-ray tube, which sweeps around the face of the tube and 'paints' the radar 'returns' once every 7½ seconds. The camera, which records this, nominally takes one frame every 15 seconds; however, detailed analysis shows this time interval to be actually 15.28 seconds. Using this datum, and the known location of the radar aerial, the ground speed of the aircraft has been estimated and is shown on the diagram at Appendix 1. The speed portrayed by these pictures, as the aircraft appeared out of the 'permanent echo' on the radar tube, is the rate at which the aircraft covers the ground: for example, an aircraft climbing vertically, at whatever speed, would appear, on radar, to be stationary.

The scale of the radar picture and the quality of the photographs makes very detailed analysis impossible, but the one minute interval between frames 1 and 5 gives a reasonable indication of the groundspeed of the aircraft and its position relative to the radar aerial.

Expert opinion is that frames 5-14, a period of 2¼ minutes, display one of the three sequences:

(i) The aircraft has broken up and the radar returns are the pieces of aircraft falling to the ground.

or (ii) The aircraft itself, although appearing to be virtually stationary, has moved fractionally to the north-east.

or (iii) The aircraft has descended, or climbed and then descended, nearly vertically, and then broken up, thereby producing the 'shower' effect of the pieces.

# 2. Analysis

## 2.1 General

The aircraft was observed to break up in the air during an apparent attempt to recover from a steep, high speed, dive. The examination of the wreckage clearly showed that the primary failure in the break-up sequence was caused by gross overloading of the outer wing structure with all other failures, including the almost total break-up of the airframe, as consequential events. All the evidence suggests that the outer wing failure was the result of a nose-up elevator input at a speed well in excess of VNE.

The most likely factors which could result in a descent of this nature are:

(i) Failure of the structure or of the flying controls prior to the final break-up

(ii) Autopilot or trim failure

(iii) Pilot incapacitation

(iv) A voluntary manoeuvre, resulting in loss of control.

These four possibilities are examined below.

## 2.2 Failure of the structure or flying controls

There was no evidence of failure or detachment of any of the structure prior to the final sequence of break-up of the airframe, nor was there any failure or malfunction of the flying controls. It is apparent that some degree of pitch control would have been necessary to produce the high positive 'g' loading required to cause the subsequent structural damage observed at the outer wings.

## 2.3 Autopilot and trim failure

It is unlikely that the pilot would have been using the autopilot when he had just requested permission to manoeuvre. However, if he was using it, there were three methods of instantly disconnecting it in the event of a malfunction. If the malfunction was a spurious elevator trim input or run-way, the electric trim motor can be overcome with ease, by a light grasp of the manual trim-wheel. In any event, there would be nothing to prevent the pilot overcoming the autopilot by normal operation of the controls.

## 2.4 Pilot incapacitation

Although incapacitation would explain an involuntary descent, there is no evidence to support this theory. The medical history and the post mortem of the pilot revealed nothing which would suggest incapacitation as a factor in this accident.

## 2.5 A voluntary manoeuvre resulting in loss of control

The request, by the pilot, for an altitude band in which to manoeuvre, suggests that he was expecting to use that airspace. This renders more likely the supposition that the initial manoeuvre from which the final one developed, was intentional. The manoeuvres which might need a height band of 1,500 feet are reasonably few, namely:

(i) An *en route* descent

(ii) A stall

(iii) Aerobatics.

These are discussed below.

### *2.5.1 An en route descent*

The position of the aircraft, its track and the pilot's request specifically to carry out manoeuvres, rule out the possibility that this event was a normal *en route* descent.

### *2.5.2 A stall*

It is possible that the pilot decided to carry out an unscheduled airtest on the flaps which had just been modified, but it is difficult to justify his implied belief that this might have needed a height band of 1,500 feet. If, during this test, he allowed the airspeed to decay down to the stall and at that point suffered an engine failure, an upset of this magnitude would be possible. There is however evidence to indicate that both engines were under power shortly before structural separation.

Further evidence against a stall having been the sole cause of the height loss is that, if carried out under normal conditions, in this type of aircraft, it is a reasonably docile event from which a rapid and positive recovery can be made. It does not involve a height loss of 5,000 feet or even require the 1,500 feet which the pilot had requested.

### *2.5.3 Aerobatics*

The Piper Navajo is an aircraft designed principally for use in the executive and 'third level' public transport roles and is therefore not stressed to the same load factors which are required for an aerobatic aircraft. For this reason aerobatic manoeuvres are prohibited in this type of aircraft. It is unlikely that a pilot who had flown G–LCCO for about 230 hours would be unaware of these restrictions and would have contemplated performing aerobatics. There are, however, indications that he was inclined to disregard some safe flying practices and regulations. The pilot himself is alleged to have said that he had rolled the Navajo; in addition, the aircraft was seen to be low flying on only one engine whilst under his command.

The radar analysis shows that the 'echo' came to a virtual standstill for about 2¼ minutes. To have produced this effect, the aircraft must have been travelling nearly vertically up or down. If the movement portrayed by the stationary 'echo' had been all in a downwards direction, it could not have lasted for 2¼ minutes. It is therefore probable that this manoeuvre comprised an upwards element and that a part of the downwards movement occurred after the break-up.

It is of relevance that the preparation for an aerobatic manoeuvre, in an aircraft which is not highly powered, is to initiate a shallow dive in order to achieve the speed necessary to perform that manoeuvre. A speed increase of the required order is indicated on the radar diagram, just prior to the apparent 'standstill'.

The aerobatic manoeuvre requiring the highest speed and having the greatest vertical dimension, is a loop or, possibly, a roll off the top of a loop. In both manoeuvres it would be necessary to keep the engines under power, in order to gain as much height as possible whilst retaining control. Both cases often involve a rather protracted near vertical climb which could well have contributed to the 2¼ minute time interval.

It is not unreasonable to postulate that a pilot, with a limited knowledge of aerobatics, in an aircraft such as the Navajo, whose engines would cut when subjected to negative 'g', might allow the aircraft to stall off the top of the manoeuvre. From that point onwards, the Navajo would be out of control for some seconds at least, and it is a matter of speculation as to exactly what its subsequent flight path may have been. However it can be stated with some certainty that, before the flight path could be stabilised, a considerable height loss would occur and that the manoeuvre would culminate in a high speed dive. This hypothesis gives the best and, it is considered, the most probable correlation with all of the available evidence.

## 2.6 Summary

There is no evidence to support the hypotheses mentioned in paragraphs 2.5.1 and 2.5.2, but there is considerable support for the belief that the pilot lost control of the aircraft during an aerobatic manoeuvre. The evidence further shows that, in the ensuing recovery from a high speed dive, the aircraft exceeded its design limitations and disintegrated in the air.

# 3. Conclusions

(a) *Findings*

(i) The aircraft had been maintained in accordance with an approved maintenance schedule.

(ii) The pilot was medically fit, properly licensed and competent to carry out the flight.

(iii) There is no evidence of failure or malfunction of the aircraft prior to its disintegration in the air.

(iv) Whilst making a ferry flight, the pilot most probably attempted an aerobatic manoeuvre, during which control of the aircraft was lost.

(v) The loss of control resulted in the aircraft exceeding VNE by a substantial margin in the subsequent dive, thereby exposing the airframe to overstress.

(vi) During the attempted recovery from the high speed dive the airframe was overstressed to the extent that it disintegrated.

(vii) Aerobatics in this aircraft are prohibited by the Flight Manual which forms part of the Certificate of Airworthiness.

(b) *Cause*

The accident was caused by the pilot attempting to recover from a dive whilst flying at a speed considerably in excess of the aircraft's permitted maximum. The excessive speed resulted from his loss of control of the aircraft, most probably following an attempt to perform a prohibited aerobatic manoeuvre.

C C Allen
*Inspector of Accidents*

Accidents Investigation Branch
Department of Trade

August 1981