Gemini Flash IIA, G-MVEP

AAIB Bulletin No: 5/2000 Ref: EW/C97/10/5 Category: 1.4

Aircraft Type and Registration:	Gemini Flash IIA, G-MVEP
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1988
Date & Time (UTC):	27 October 1997 at 1059 hrs
Location:	Roydon Hamlet, Essex
Type of Flight:	Private (Training)
Persons on Board:	Crew - 1 - Passengers - None
Injuries:	Crew · 1 Fatal - Passengers · N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Student pilot
Commander's Age:	43 years
Commander's Flying Experience:	31 hours (all of which were on type)
	Last 90 days · 18 hours
	Last 28 days · 11 hours
Information Source:	AAIB Field Investigation

This bulletin provides information on tests tothe Flash 2A wing carried out since the accident. The information presented inthe original bulletin is repeated to put the test results in context.

History of flight

The pilot was on a qualifying solocross-country flight for the award of a Private Pilots Licence. The plannedroute was from Hunsdon Airfield, near Harlow, Essex to Headcorn Airfield inKent, where the aircraft would be refuelled for the return flight to Hunsdon.There was low cloud in the area and the pilot was briefed to return to Hunsdonif this became a problem; the planned altitude was 1,500 feet initially andthen 2,000 feet.

The pilot had programmed his route into hisGlobal Positioning System (GPS) equipment. Data stored in the GPS was used todetermine, in part, the history of the flight. At 1032 hrs, the aircraft tookoff from Hunsdon Airfield and flew a complete left hand circuit before trackingsouth down the western side of Harlow. At 1042 hrs the aircraft turned left andtracked east, over Junction 7 of the M11 towards the village of Moreton. At1051 hrs, shortly before it reached Moreton, it made a 180° turn to the leftand tracked along the southern edge of Harlow. It then turned to track northand, shortly afterwards, the GPS stopped logging data. The last relevantposition logged was at 1058 hrs after the aircraft had started a left turn in aposition about 260 metres northeast of the accident site. The final part of thetrack was confirmed by comparing it with recorded data from Heathrow radar; thetime of the final return was also 1058 hrs.

Witnesses were consistent in theirobservations. They reported hearing a sharp crack and seeing the left wingmove up almost to the vertical. Shortly afterwards the right wing did the sameand, the aircraft spiralled to the ground with the wings folded together andthe trike assembly describing a circle beneath them. The aircraft was in thevicinity of the final GPS/radar contact when the observations were made and onewitness called the emergency services while it was still falling; the call wasrecorded at 1058 hrs.

The pilot survived the impact but diedshortly afterwards from his injuries. Post mortem examination revealed nopre-existing medical condition which would have contributed to the accident.

Pilot's flying experience

The pilot started a course of microlightflying training in March 1997. Initial training was in a Mainair Bladeaircraft. His first flight in the Gemini Flash IIA, G-MVEP, was on 26 August1997. He made good progress through the course and went solo on 20 September1997 after 19 hours. His last flight before the accident was on 26 October1997, after which he had flown a total of 19 hours dual and 11 hours 40minutes solo.

Meteorology

An aftercast was obtained from theMeteorological Office at Bracknell. There was a weak cold front lying fromKings Lynn to Folkestone; it was moving slowly westwards.

Surface wind	100°/10 kt
2,000 feet wind	130°/15 kt
Visibility	9km
Cloud	FEW base 600 feet
	SCT base 1,000 feet
	BKN base 4,500 feet
Temp/Dew point	+10C/+8C
QNH	1027 mb

Global positioning system

The GPS equipment carried in the aircraftworked throughout the accident flight. It uses satellite navigation toestablish its position which it then displays on a small screen. The equipmenthas a logging facility which saves position, time and date into non-volatilememory, on a periodic basis when direction or speed change significantly. Theequipment was found to operate satisfactorily after the accident.

The data logged during the accident flightwas downloaded onto a computer. As the downloaded data was based on a datumother than that used for Ordnance Survey maps, a correction factor was appliedto each latitude/longitude point logged and the results plotted onto a 1 to25,000 map. The plotted points correlated well with the known positions of thetake off and the accident. It was not possible to determine the height of theaircraft during any part of the flight as GPS altitude, although displayed onthe screen, is not logged in the non-volatile memory.

From 1058 hrs, the GPS stopped logging datafor a period of twenty four minutes. It is considered that this was because theGPS was unable to receive sufficient satellite signals to calculate itsposition. It was probably carried in the document pocket on theright side of the aircraft and consequently the accuracy of the recorded datamay have been degraded because of satellite obscuration by the pilot or themetal framework of the aircraft. This degradation may have been more noticeablewhen tracking west as five of the eight satellites in view would have beenbehind the aircraft.

Further geographical positions consistentwith that of the accident site were recorded in the equipment; two points at1122 hrs, two points at 1229 hrs and a period of uninterrupted operation from1406 hrs to 1443 hrs. It is likely that, as the aircraft wreckage was movedduring the post accident recovery, the GPS may have periodically receivedadequate satellite signals before it was eventually turned off when the AAIBarrived on the scene.

Accident site

The microlight was found lying on its lefthand side with the wing folded in two. The only significant ground mark hadbeen made by the muffler and did not show any signs of aircraft rotation. Theguarded magneto switch was found in the off position. The aircraft wascarrying 50 kg of ballast in an appropriate container.

The propeller had disintegrated and themajority of it was retrieved from a 400 metre long trail, however only 45% ofthe leading edges was recovered. The fabric nose cone was found 275 metres fromthe accident site along the line of the propeller debris. No vibration damagewas apparent on the engine mounts, muffler, air filter or engine casing.

Subsequent examination at the AAIB facilityat Farnborough revealed heavy indentations on the lower left hand side of thekeel, and wood dust embedded in the left vertical face of the keel fabric inthe area over the indentations. The indentations were very similar to keeldamage on another wing which was known to have had a propeller strike on the keel.

The following structural damage had occurred before the microlight hit the ground:

The outer 1.33 m of both leading edge tubes had broken in a downwards direction.

The right hand leading edge tube had detached from the nose plate.

The control bar had failed at the inner end of the right hand grip by being forced through thefront strut; the front strut had a corresponding slight bend.

The wires on the upper wing did not show anycurling typically associated with excessive tension, and the king post wasundamaged by compression. The structural damage was consistent with negativeg and the trike dropping into the wing. The aircraft had a renewal of itscertificate of validity on 30 July 1997 and had flown for a total of 152hours, and the log book did not contain any record of significant maintenanceactions.

Insufficient evidence of this accident hasbeen accumulated to determine the cause with any degree of confidence. The AAIBtherefore intend to rebuild the sail, using as many of the original parts aspossible, with the initial objective of determining the pitch moment and stallcharacteristics of this specific wing. The results of these tests will bepublished when they are available. (Original Bulletin text in the future tense,tests complete to date are reported on below).

Tests

A series of tests were carried out in March1998, using the British Hang Gliding and Paragliding Association's (BHPA) testrig at Rufforth to determine the lift and pitching moment vs angle of attack(AoA) graphs. The results implied that the wing could become unstable in pitch,but the accuracy of the data was insufficient to provide an adequate degree ofconfidence in the results. Accordingly, it was decided to retest the wing on anew rig that the BHPA intended to buy, with better control, instrumentation anddata logging. After many delays in delivery and provision of adequate software,the tests were rerun in September 1999.

The test data were analysed by the BMAA (seegraph); and the results for 45 kt and a weight of 283kg are discussed. Under these conditions the lift coefficient vs AoA graphgives a flight AoA of 7° in level flight, or 6° in a maximum descent.

The graph for pitching moment vs angle ofattack *for this wing* shows that a maximum (at which bar forces reducefor either an increase or decrease in AoA) occurs in pitching moment atapproximately minus 7 1/2° AoA. A similar result was shown for 48 kt, althoughnot for 38 kt. If the wing's angle of attack were to reduce below this value,it could be expected that the wing would become divergent in nose-down pitch,probably leading to a loss of control and in-flight breakup. Thus in the bestpossible conditions, an angle of attack change of -14 1/2° would have this result. The strength of a downward gust to cause this change would be 11.63 kt.

Using the JAR-VLA formula, a gust with amaximum strength of only 15 kt would require a time of 0.33 seconds to go fromstill air to the strength of 11.63 kt required to cause a departure. The timedelay will reduce as the maximum strength of the gust increases. This would notbe sufficient time for the pilot to react to the gust in any useful way.

It is also noteworthy that, at around thetrimmed condition, the wing shows low to neutral pitch stability, althoughnever becoming divergent around this condition. This is consistent with thedescription of this aircraft's flying characteristics given verbally by themanufacturer's test pilot, who considered that this characteristic was poor andshould be corrected.

The analysisof the test data remains subject to some uncertainty, particularly with regardto the relationship between steady state and dynamic aerodynamic characteristicsof the wing; the latter are not possible to determine with any currentlyavailable test facility.

Conclusions

These results indicate that the wing ofG-MVEP, rigged as it was for the accident flight, has characteristicsthat could cause it to become divergent in nose down pitch through the actionsof a vertical gust of a strength that could reasonably be expected in Britishsummer flying conditions. The onset of this gust associated departure would besufficiently rapid so as to preclude any significant pilot recovery responsebefore the manoeuvre was catastrophic.

This is only evidence from this one wing. Asthe manufacturer's test pilot considered that it was not trimmed correctly nearthe trim point, it may not be representative of other similar wings in service.The Flash 2A has a great many adjustment points, and it is possible that thiswing may have been adjusted to give near neutral pitch stability, which someexperienced microlight pilots consider to be desirable as it reduces pitch barforces in cruising flight.

Further work

Since 1986, there have been 12 accidents toFlash 2 and 2A wings in the UK in a variety of circumstances, involving a lossof control in flight. Some of these accidents were accompanied by inflightbreakup, and seven lives were lost. The tests carried out indicate only thecharacteristics of one specific example of a Flash 2A and the AAIBconsiders there is a need for further test work. The AAIB intends to determinewhy this wing was unstable in pitch, and whether other Flash2/2A wings aresusceptible to the same problem. This programme will include finding aFlash 2A wing with a trouble free record and testing it on the BHPA rig, withadjustments as may seem necessary at the time.

The AAIB also consider that tests should be carried out on a range of otherwings, to include, Pegasus, Raven and Flash 2 wings, to put the Flash 2Aresults into context; and make the following safety recommendation.

Recommendation No 2000-22

It is recommended that the BMAA determinethe lift and pitching moment characteristics of a range of wings,to include, the Pegasus and Raven wings, to provide data to help definean adequate standard.