AAIU Report No.2001/017
AAIU File No.2000/0045
Report Published 21 November 2001

Aircraft Type and Registration:	Jabiru UL Ultralight G-BXNU
No. and Type of Engines:	One Jabiru 2200
Aircraft Serial Number:	PFA 274-13218
Year of Manufacture:	1997
Date and Time (UTC):	22nd July 2000, 14.56 hours
Location:	Minnistown, Co. Meath.
Type of Flight:	Private
Persons on Board:	One
Injuries:	Multiple injuries to pilot
Nature of Damage:	Substantial damage to aircraft
Commanders Licence:	Private Pilots Licence (UK)
Commanders Age:	44 years.
Commanders Flying Experience:	350 hours (200 hours on type)
Information Source:	ATC Watch Manager, Dublin Airport AAIU Field Investigation

SYNOPSIS

Following a 20 minute flight the aircraft stalled in a left base turn to land at Minnistown private airfield. The aircraft landed heavily in a small field and inverted.

1. FACTUAL INFORMATION

1.1 History of the Incident

1.1.1 The pilot had originally intended to fly to Newtownards, Co. Down, where a "fly in" was taking place that week-end. Prior to doing so, he decided to take off from his private airstrip for a short local flight in his area.

He was aware that there was some turbulence at a height of 1000 ft. He conducted a few passes over the runway before deciding to practice a "short field landing". During this practice he was at 200 ft. before turning left base for Runway 09. After turning left base the aircraft experienced a lot of "sink"and was in a banked turn of 60 to 70 degrees. The pilot said he applied right rudder to try to get the aircraft out of the excessive bank angle. This did not work so he started to gradually feed in an increase of engine power. By this time the left wing tip had touched the ground. The aircraft impacted the ground with its nose wheel, thereby dislocating the nose strut, tumbled over on to its back and came to rest close to a ditch bordering the field. The pilot found himself suspended from his seat belt. The auxiliary fuel pump was still running (used for landing) so he reached up and switched off the electrical master switch. The pilot said that on turning left base he was just within the flap operating range of 70 kt and lowered the flaps to stage one (i.e. 15 degrees). He noticed, on exiting the aircraft, that the flaps were still at this setting. The pilot extricated himself from the aircraft unaided and dialled 999 on his mobile phone. He then alerted the AAIU and informed the investigators of the accident.

1.1.2 Later, in a frank and open discussion with the Investigation, he said that he thought that, on reflection, he had too much bank angle and not enough height during the turn.

The pilot estimated T.O. weight at the time of the accident was:-

Empty weight	240 kg
Crew	91 kg
40 litres fuel	30 kg
Total	361 kg

1.2 Injuries to Persons

1.2.1

Injuries	*Crew*	*Passengers*	*Others*
Fatal	Nil	Nil	Nil
Serious	One	Nil	Nil
Minor/None	Nil	Nil	Nil

1.2.2 The pilot sustained injuries to his left shoulder, broke his sternum and had spinal fractures around the waist area. Due to excessive pressure exerted on the right rudder pedal, he tore some ligaments in his right foot. He was hospitalised for six days as a result of his injuries.

1.3 Damage to Aircraft

The left wing was torn from the fuselage, the propeller had broken off from the hub assembly, the nose-strut and nose wheel having separated from the aircraft. There was extensive damage to the cockpit box area, with only the right-hand door retaining its shape.

1.4. Other Damage

There was some local damage to the standing crop at the immediate crash site.

1.5 Personnel Information

The pilot has a current Private Pilots License (PPL-A) issued by the UK CAA and has a total of 350 flight hours on microlight aircraft. He is a member of the BMAA (British Microlight Aircraft Association)

1.6 Aircraft Information

The Jabiru is a two seat Light Sports Aircraft (LSA) of Australian origin. It is manufactured of glass fibre reinforced plastic (GFRP) except for the metal wing struts, nosewheel assembly and engine mount. The aircraft is fitted with a flat-four cylinder engine with electric starting and a two-blade fixed-pitch wooden propeller. The design had originally a 60 HP engine, certificated in Australia in 1991 and was produced as the Jabiru ST. The Jabiru ST with an 80 HP engine was introduced in 1994 and factory manufactured alongside a quick–build kit of the same version known as the Jabiru SK. The first UK kit was delivered to an importer in June 1996 and flown in Oct.1996. The aircraft is also designed to British Civil Airworthiness Requirements (BCAR Section S). By 1997 there were more than 120 Jabirus flying worldwide. Production of complete and kit aircraft totalled 300 by early 2000.

The increased power affected the flight parameters as follows:-

- Max T.O. weight from 430 kg to 449 kg
- Max level speed from 99 kt to 116 kt
- Max R.O.C from 800 ft/min to 1000 ft/min.
- Take Off Run from 275 M to 100 M
- The Empty Weight equipped, remained the same at 235 kg.
- Max IAS with flaps extended: 70kts

The Jabiru UL is a variant of the above aircraft, having extended wingspan and tailboom and altered fin surfaces. Some of the differences include:-

- Wing span increased from 8030mm to 9398mm
- Overall fuselage length from 5000mm to 5640mm
- Max T.O. weight from 449 kg reduced to 430kg
- Wing struts extended
- Additional stiffener and bulkhead introduced

- Ventral fin of reduced size fitted, fin strake of increased size fitted.
- Propeller of increased diameter and reduced pitch fitted.

This aircraft variant was designed in the hope that it would eventually qualify as a microlight under the then proposed 450 kg microlight revision but at the time was outside the microlight definition. Therefore the variant was classified as a "Group A" aircraft which required the pilot to have a PPL-A licence rather than a microlight's pilots licence (PPL-D). Later the CAA introduced the "Small Light Aeroplane" category which extended the privileges of a microlight up to an MAUW of 450 kg. This allowed the Jabiru UL to be re-classified as a Small Light Aeroplane rather than Group A.

G-BXNU was the first UL variant imported into England and assembled by the UK agents during 1997/1998. A Certificate of Registration was issued by the CAA to the present owner on the 31 Oct. 1997. The date of construction as per the airframe logbook is given as 27 March 1998. The present owner spent up to 10 days at the construction site during the assembly and finishing of his aircraft. The first test flight took place on 2 April 1998.

In June 1998, the Popular Flying Association (PFA) made a submission to the CAA to have the variant approved. The PFA Engineering system exists to cater for the airworthiness certification of amateur-built aircraft. Aircraft must be amateur built by its owner.

At that time the aircraft had already accumulated 21 hours under test. The PFA design investigation stated:- *"Where the submission is lacking, in-service experience with the Jabiru SK version has been used as a basis on which to support a recommendation."* It was stated that a number of alterations had to be made as a result of the load test program carried out on a test airframe at the factory in Australia. Reinforcement of wing roots and carry-throughs, which failed on the test airframe during preliminary testing, had to be strengthened and retested. Modifications had to be incorporated in order to bring the aircraft to a satisfactory design standard. G-BXNU was fitted with all the structural reinforcements as defined in the submission.

1.6.1 Jabiru UL CAA Flight Test and Delivery.

The aircraft was test flown by the CAA Flight Department on 8 June 1998. Handling was found to be normal throughout, with benign stall characteristics, adequate stall warning, positive pitch stability but relatively weak, marginal directional stability, nevertheless considered compliant with the BCAR Section S requirement. The uncoordinated roll rate was hampered by very marked adverse yaw. It was considered that increased directional stability would be desirable. Nevertheless it was considered that the aircraft was adequate for the issue of a Permit to Fly as tested.

On the 25 June 1998 the PFA issued the Operating Limitations, which form part of the CAA Permit to Fly, for operation of G-BXNU. For all CAA and PFA documents, the owner is designated as the constructor. There is no requirement for an aircraft Certificate of Airworthiness when a Permit to Fly has been issued and is valid. The PFA also issued a serial number for this aircraft. The owner said that he collected the aircraft, following some training, from the UK on 3 July 1998. At this time the aircraft had accumulated 22 hours of flight.

The Permit to Fly was issued by the CAA on the 7 Sept.1999 under Small Light Aeroplane classification subject to the Operating Conditions and Limitations. An annual Certificate of Validity (i.e. inspection and flight test) also forms part of this Permit to Fly. It is restricted to flight within the UK and states that *"Permission for flight over any foreign country must be obtained from the airworthiness authority of that country."*

On 13 May 2000, after 176 hours of flight, the owner fitted a 3-bladed propeller supplied by a manufacturer in the Czech Republic and flight tested the modified aircraft. The log book records the flight test as "OK". This propeller was removed and refitted in lieu of the two bladed one on a number of occasions prior to the accident. At the time of the accident the three-bladed fixed-pitch propeller had been fitted.

Fuel is held in a single fuselage tank of 60 litres (15.6 US gals) capacity. The maximum take-off and landing weight is 430 kg. According to the Aircraft Flight Manual (AFM), supplied with the aircraft, the stalling speed in level flight with flaps up is 45kts and 33kts in a landing configuration with flaps fully down.

The aircraft is inspected annually by an aircraft inspector on behalf of the PFA. The last date of such inspection, as inserted in the aircraft logbook, was the 7 July 2000. The inspector said that at the time of the inspection the aircraft was serviceable and fitted with a two bladed propeller.

The AFM, as presented to the Investigation, did not bear the registration or serial number of the aircraft and therefore had nothing to identify it to the aircraft in question.

1.7 Meteorological Information

General Situation:	A low pressure system to the south of Ireland and an Anticyclone centred to the north of Scotland maintained an East-south-easterly flow over the area.	
Wind:	At surface:	090-110/12kt
	At 2000 ft:	110-120/20 kt
Weather:	Nil	
Visibility:	10 + kilometres	

Cloud:	FEW 2000 ft
Temperature/: Dew point	19/13 Celsius
MSL Pressure:	1023 hPa

The forecast issued for nearby Gormanston Aerodrome valid 1300 to 2200 UTC on the day in question was:

EIGM 221200Z 221322 07012KT 9999 FEW020=

Temperature lapse rates and the lack of convective cloud suggest low levels of instability and thermal activity. The gradient was sufficient to generate occasional moderate turbulence at most.

1.8 Aids to Navigation

Non applicable

1.9 Communications

Non applicable

1.10 Aerodrome Information

The 350 m grass runway running 09/27 is located in a field adjacent to the owners residence.

1.11 Flight Recorders

There were no flight recorders on board nor were they required.

1.12 Wreckage and Impact Information

The aircraft was extensively damaged. The nose strut and spat were ripped off from the fuselage on impact, the port strut was damaged but remained with the fuselage. The port wing had broken off and was severely damaged at the wing root. The port door was badly damaged. All the propeller blades had broken off and only the hub remained with the aircraft. Most of the Perspex windows had shattered on impact.

A repair and maintenance company collected the aircraft wreckage, including some severely damaged parts, from the owners premises on the 23 Sept 2000.

1.13 Medical Information

Not Applicable

1.14 Fire

There was no fire.

1.15 Survival Aspects

The pilot was restrained by a three-point harness.

1.16 Tests and Research

The severely damaged parts were placed in a box. These included the propeller hub, nose spat, Perspex windows and other GRP parts from the airframe. It is estimated that only 30% (by weight) of these items had survived the accident.

The aircraft wreckage, excluding the boxed items, was weighed by the Repair and Maintenance company. The company used a recently calibrated CAS digital scales with a maximum allowable load of 600 kgs. The weight registered was 270.35 kg. This figure was found to be 23 kg above the stated empty weight of 247.27 kg in the aircraft inspection schedule. It is estimated that the above boxed items would account for another10 to 15 kg. To fit in the category of a Small Light Aeroplane in accordance with BCAR Section S paras 23, 25 and 29, the empty weight should not have exceeded 247 kg. As the aircraft's empty weight was deemed outside the legal requirements the company declined to conduct a repair. The company said that they invited the PFA to view the wreckage but this visit did not materialise.

Shortly after this accident the PFA carried out a random check weighing on another Jabiru UL and the results confirmed the original weighing results and indicated that there was not a universal problem with Jabiru weights.

The wreckage was then collected from this company and returned to the UK agents. They stated that they weighed the damaged airframe and confirmed that with the exception of a GPS receiver the aircraft was as weighed by them in 1998. The investigation requested a copy of the original Weight of Balance Schedule from the Agents. This indicated that the empty weight on 17 March 98 was 247.27 kg. Copies of photographs of the scale readings were forwarded to the investigation. The aircraft was weighed using basic "analogue" scales.

1.16.1 Initial aircraft flight test

Prior to the issue of an initial Permit to Fly this aircraft was flight tested and a subsequent report issued. Extracts from the table on stalling include the following:

Stall Configuration	Stall (kt)	Comment
30º left, power idle		
Clean	51	No roll
Full flap	44	No Roll, stick hard back.
30º left, 3000 RPM		
clean	50	Rolled out
Full flap	40	Rolled out.

The test pilot comments included the following:-

"The speeds recorded were indicated and to meet the new BCARs requirement (34kt) would need to be slightly lower if the PE error is not large".
(PE. Positional Error due to position of static vent)

1.17 Organisational Information

The UK CAA "Permit to Fly" states that *"permission for flight over any foreign country must be obtained from the airworthiness authority of that country."* However no permission was ever sought or granted from the IAA to conduct flights with G-BXNU within the Republic of Ireland. Airworthiness Notice NR A.19, issued by the IAA on 8 April 1998, grants permission for a home-built or amateur built aircraft, registered in a Member State of the European Civil Aviation Conference and issued with a flight permit, to fly in Ireland. This does not negate the owners obligation to request the IAA to accept the operation of the aircraft within the Republic of Ireland.

1.18 Additional Information

1.18.1 Permit to Fly

The Permit to Fly Operating and Limitations item 6 specifies that: *" No alterations, modifications or replacements shall be made to this aircraft or to its engines, propellers, or equipment unless approved by the CAA or other Organisations approved by the CAA for that purpose."* The CAA said that considering that the propeller modification was not approved, the Permit to Fly for this aircraft was therefore invalid during the period this unapproved modification was installed. The Permit to Fly was therefore invalid at the time of the accident.

The UK assemblers of the aircraft at first stated that the above propeller was approved by Jabiru Pty Ltd. This was found not to be the case. It was then stated that the PFA were evaluating the design of the 3-bladed propeller but that it had not yet been approved.

1.18.2 Propellers

The PFA Type Data Sheet indicates that one of the differences between the standard SK model and this U.K. variant is the propeller of increased diameter and reduced pitch (1538 mm x 864 mm or 60.5" x 34" pitch). This was fitted to the aircraft on delivery. The SK model has a 60" x 40" pitch. However, the aircraft's Noise Certificate issued by the CAA indicates that the latter propeller was fitted to this aircraft. The AFM indicates that the propeller 56" x 41" pitch (1422 mm x 1040 mm) should be fitted.

1.18.3 Short Field Landing Technique

The AFM technique for a short field landing indicates that the flap should be set at full flap (i.e. 30°).

1.18.4 Flight Manual

The PFA state that there is no requirement for a flight manual to be issued under the Permit to Fly Category. However, the Australian manufacturers state on the published flight manual issued with the aircraft that "This AFM applies only to the particular aircraft identified by the registration marking and serial number on the Approval Page and contains the airworthiness limitations and essential operating data for this aircraft". In addition, the BCAR requirements to which this aircraft was designed, under Section S 1581(a) demands that a pilots handbook be furnished with each aeroplane.

2. ANALYSIS

It is clear that doubt exists as to the exact empty weight of this aircraft. The empty weight could have been in the region of 285 kg. for an aircraft with a stated empty weight of 247 kg. Both the Agents and the Maintenance company appear to have confidence in their figures. It would therefore come down to a comparison of the measuring devices used. For aircraft work a digital weighing scales is known to be more accurate and dependable than an analogue type and therefore more confidence would be placed on this type. The question would also arise as to whether the scales in each case were "valid for trade".

The pilot estimated that the T.O. weight of the aircraft was 361 kg. With the increased empty weight the take off weight could have been nearer to 400 kg. However, it is not possible to say where the centre of gravity was as the position of the extra weight was not known.

Both the owner and the U.K.Agent confirm that no modifications were incorporated after build, which would have led to an increase in the empty weight. The installation of the unapproved 3-bladed propeller should not have led to the amount of increased weight as only the propeller hub remained, and this was not included in the measured weight of 270.35 kg.

The increase of stalling speed with bank angle follows the general law demonstrated by the graph on page 10. On G-BXNU, the percentage increase in stalling speed increases further as flaps are extended. With engine power on, the stalling speed decreases slightly. However, the left wing had already stalled before engine power was increased. The estimated stalling speed for a ½ stage (15º) flap in accordance with the flight test results would be in the region of 45 kt at 30º left bank. At a 60º to 70º left bank, the stalling speed could have been in the region of 60 kt. The pilot indicated that when he set the flaps the speed was less than 70 kt. (i.a.w. the AFM). It is likely therefore that a condition for a stall in the turn existed and that insufficient height was available for recovery. Also, the input of right rudder at this time could have induced the onset of an initial spin. The fact that the aircraft failed to respond to aileron indicates that at least the inner wing outer section had stalled. For a short field landing as intended, the flaps should have been set at full flap.

It would appear reasonable that an aircraft of this type should have an officially approved flight manual bearing the serial number or registration number of the aircraft, if only to be used as a look-up reference by the pilot. (eg: short field landing performance).

The PFA require that the aircraft be built by its owner. The owner was duly designated by the CAA as the constructor of the aircraft.

3. CONCLUSIONS

(a) Findings

3.1 Doubt exists as to the empty weight of the aircraft. The T/O. weight was below the maximum allowable AOW of the aircraft, but doubt also exists as to the position of the C of G at the time of the accident.

3.2 The installation of the 3- bladed propeller was unapproved and it is not possible to say what effect this modification had on the performance of the aircraft under the conditions prevailing near the stall.

3.3 The aircraft flight manual supplied with the aircraft was not certified as belonging to the aircraft and could not be relied upon to represent aircraft performance.

3.4 The practice of modifying aircraft outside the manufacturers specifications is unacceptable.

3.5 Permission was not sought from the IAA for permission to fly in or over Ireland as required by the Aircraft's Permit to Fly.

(b) Causes

The aircraft stalled in the final turn as excessive bank angle was applied.

4. SAFETY RECOMMENDATIONS

4.1 The PFA should consider the inspection of the Flight Manuals supplied with the aircraft kit in order to ensure that the details therein are in agreement with the published specifications for the type. **(S.R. No.44 of 2001)**

4.2 The PFA should also ensure that the manual bears the registration number of the aircraft and the PFA aircraft serial number. **(S.R. No.45 of 2001)**

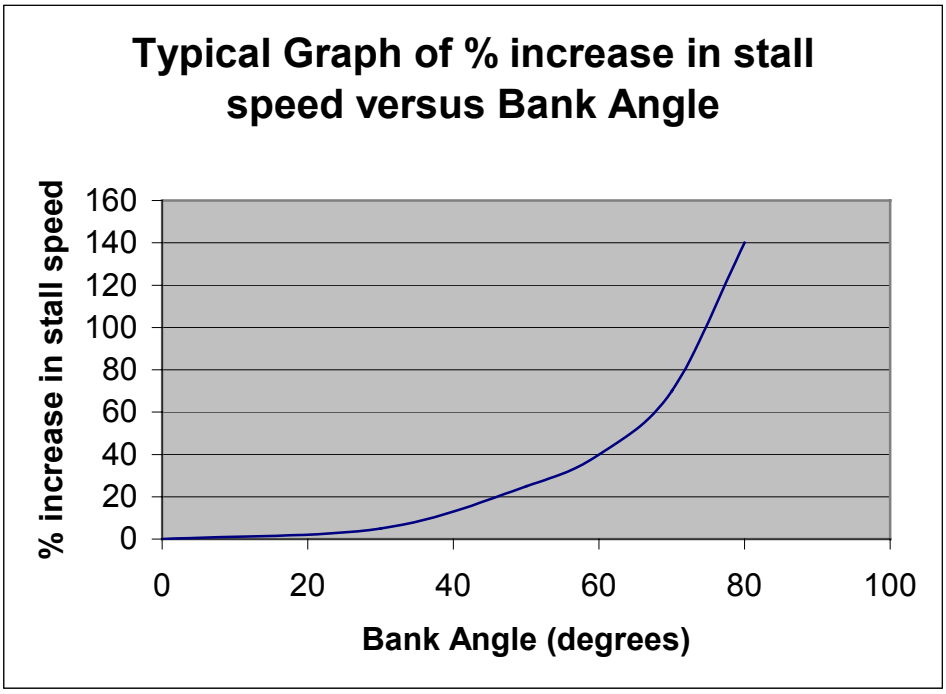

Photo of G-BXNU with two bladed propeller installed.