ACCIDENTS INVESTIGATION BRANCH
Department of Trade and Industry

Moravan Zlin Z526A G-AWAR
Report on the accident at Hullavington, Wiltshire on 3 June 1970.

LONDON: HER MAJESTY'S STATIONERY OFFICE
1971

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SBN 11 510644 8

Department of Trade and Industry
Accidents Investigation Branch
Shell Mex House
Strand
London WC2

28 July 1971

The Rt. Honourable John Davies MBE MP
Secretary of State for Trade and Industry

Sir,

I have the honour to submit the report by Mr R C Warren, an Inspector of Accidents, on the circumstances of the accident to Moravan Zlin Z526A G-AWAR which occurred at Hullavington, Wiltshire on 3 June 1970.

I have the honour to be

Sir,

Your obedient Servant,

V A M Hunt
Chief Inspector of Accidents

Accidents Investigation Branch

Civil Accident Report No. EW/C348/01

Aircraft:	Moravan Zlin Z526A G–AWAR
Engine:	One Walter Minor M6-111
Registered Owner:	Messrs J M K Black, C Schofield and C Taylor
Pilot:	Mr N M Williams – uninjured
Place of Accident:	Hullavington, Wiltshire
Date and Time:	3 June 1970 at 1200 hrs
	All times in this report are GMT

Summary

When the pilot was practising aerobatics over Hullavington airfield a loud bang was heard and the port-wing deflected upward causing the aircraft to roll to the left. The pilot inverted the aircraft thereby allowing the airloads to restore the port-wing to its normal position and remove the rolling moment; the handling characteristics were then assessed while an inverted circuit was carried out. An approach to land was made and at the last possible moment the aircraft was rolled into normal flight position and immediately landed before upward deflection of the port-wing rendered the aircraft uncontrollable. Examination of the centre-section showed that the port lower front spar boom had failed in fatigue.

1. Investigation

1.1 History of the flight

The object of the flight was to practise aerobatics for the forthcoming World Aerobatic Championships.

The aircraft took off from Hullavington airfield on its third flight that day and went through a set aerobatic sequence twice during which time the aircraft behaved normally. During the third sequence the pilot was recovering level erect flight from a vertical dive, pulling +5 'g' at a height of about 1,000 feet, when there was a loud bang and a jolt was felt in the aircraft which then commenced to roll to the left. This roll could not be checked despite the use of full right aileron and right rudder and it was apparent to the pilot that the left wing was deflecting upward. His intention at this time was to land the aircraft as soon as possible but by the time he had descended to 300 feet it was clear that all control was about to be lost. He therefore reversed the aileron, applied negative 'g' and rolled the aircraft to the inverted position. The pilot, who was not wearing a parachute, then found that he could fly the aircraft normally in inverted flight. A circuit of the airfield was completed, climbing to 1,000 feet whilst the handling of the aircraft was assessed. Having decided to land wheels retracted an inverted approach was made and at the last moment the pilot rolled the aircraft to the right into normal attitude. Negative 'g' was maintained during the roll-out to hold the wing in position and as this was released just prior to impact the wing again started to fold. The aircraft came to rest after a ground slide of about 70 yards, during which it swung 90 degrees to the left. The pilot was slightly bruised and was able to leave the aircraft without assistance.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	-	-	-
Non-fatal	-	-	-
None	1	-	-

1.3 Damage to aircraft

Severe damage was sustained during the wheels-up landing and the ground slide. The aircraft was a constructive total loss.

1.4 Other damage

None.

1.5 Crew information

Mr Neil Meredith Williams, aged 36, commenced flying in 1951. He served in the Royal Air Force as a pilot from 1955 to 1967 and in 1962 he graduated at the Empire Test Pilots School. Prior to leaving the RAF he was posted to the Royal Aircraft Establishment for pilot duty with the Experimental Flying Department.

Mr Williams' total flying time amounted to 6,500 hours, including approximately 300 hours on the Zlin Trener type. At the time of the accident he held a valid commercial pilot's licence which has since been superseded by an airline transport pilot's licence. Since 1962 Mr Williams has been an active participant in international aerobatic competition flying.

1.6 Aircraft information

G–AWAR was built by Moravan NP, Otrokovice, Czechoslovakia in February 1968. Its type designation was Zlin Z526A, Constructor's No. 1036. Manufactured by the Czech national aircraft industry the "Trener" series of aircraft are single-engined training aircraft in the aerobatic category. The 326 and 526 two-seater variants are capable of advanced aerobatics, the Z526A is a single seat version of the aircraft intended for aerobatic competition flying. The life of the aircraft in this role is 2,200 hours operating at load limits of +6 'g' and -3 'g'. G–AWAR was purchased by a syndicate so that members of the British aerobatic team had access to an aircraft capable of advanced aerobatics in preparation for the World Aerobatic Championships 1970. The major part of its flying life had therefore been spent in carrying out such aerobatics. G–AWAR had completed a total of 452 hours 35 minutes flying, of which 82 hours 40 minutes had been flown since its Certificate of Airworthiness was last renewed on 19 February 1970. During its life it had been maintained in accordance with the manufacturer's technical instructions. The last maintenance carried out was a 25 hour inspection on 21 May 1970. A normal pre-flight inspection was carried out prior to take-off on 3 June 1970. All relevant maintenance instructions and service bulletins had been complied with and there was no record of any defect or repair which could be considered to have any bearing on the accident.

No evidence was available to the investigation to show the maximum 'g' loading the airframe structure had been subjected to during its operational life.

1.7 Meteorological information

The weather at the time of the accident was fine and there was no turbulence. There was 2/8 cumulus cloud with a base at 3,500 feet. The wind was south-west at 5 to 10 knots. It is considered that the weather had no bearing on the accident.

1.8 Aids to navigation

Not applicable.

1.9 Communications

The aircraft was not equipped with radio.

1.10 Aerodrome and ground facilities

RAF Hullavington is a non-flying unit and the airfield is designated as disused, although it may on occasion be used with prior permission. The airfield is located within the Lyneham Special Rules Area and a direct telephone line is maintained between Lyneham Air Traffic Control and Hullavington. By arrangement with the Ministry of Defence the airfield was to be the venue for the 1970 World Aerobatic Championships, the airfield and hangar accommodation had been made available to the British team for practice purposes. Arrangements were made for the British team to operate in pairs, one pilot remaining on the ground where he could receive any communications from Lyneham control and if necessary recall the practising aircraft by means of light signals. This procedure was in effect at the time of the accident and fire and medical services were alerted before the aircraft had landed.

1.11 Flight recorder

Not required to be fitted.

1.12 Wreckage

Examination of the wreckage revealed that the centre-section lower front spar boom had fractured and separated on the port side at a point adjacent to the outer landing gear pivot bracket weld. (Note: the centre-section spar is a welded steel tubular structure comprising upper and lower booms connected by bracing members.)

The upper spar boom and wing joint were bent upward with associated damage to the bracing structure, rear spar attachments and port side fuselage. According to the condition of the structure it appeared that the wing had flexed upward at least 20 degrees. The outer mainplane attachments consist of upper and lower pin joints; the fact that the upper attachment joint pin is located vertically and the lower pin horizontally allowed the upper spar boom to react against the bending loads following separation of the lower boom. The aileron circuit remained connected, a pin joint in the rod circuit

allowing it to flex with the wing. The starboard side of the centre-section spar structure remained attached but subsequent examination revealed a small crack in the lower boom at a position corresponding to that where the failure occurred on the port side.

All other damage observed was consistent with the belly landing and subsequent ground slide.

1.13 Fire

No fire occurred.

1.14 Survival aspects

Not applicable.

1.15 Tests and research

The failed pieces of the centre-section port lower front spar boom together with the cracked section from the starboard side were sent to the Materials Department, Royal Aircraft Establishment, for metallurgical examination, and subsequently to the manufacturer. Their reports confirmed that the failure was due to fatigue and indicated that the material was in accordance with its specification and that there was no material or welding defect which had initiated the fatigue crack.

2. Analysis and Conclusions

2.1 Analysis

The centre-section spar construction is common to Z226, Z326 and Z526 series aircraft which have been produced in large numbers and operated in all parts of the world. It is understood that this is the first case in which fatigue cracking of the structure has led to an accident.

Following the accident Moravan undertook the checking of every aircraft likely to be involved in competition aerobatics with the result that of approximately 100 aircraft examined two Z526A aircraft were found to have cracks in the same position as those found on G–AWAR. Both these aircraft had flown comparable hours with G–AWAR and had been subject to the same type of usage, ie aerobatics in preparation for the World Championships. The life of other aircraft in the series is unlimited but the Z526A aircraft is limited to 2,200 hours in the aerobatic role when operated to limits of +6 'g' and -3 'g' loading. When an aircraft of this type was cleared to operate at limits of +7 'g' and -4.5 'g' its aerobatic life was reduced to 100 hours. The reason for this limitation was that high loads may reduce the fatigue life significantly and it was recognised that the role of the Z526A aircraft was one in which high loading was likely to occur.

The metallurgical examination of the failed specimens indicated that there was no material failure or deficiency which had initiated the fatigue cracks.

In view of the absence of any form of data recording on the aircraft, the loads to which it had been subjected during its life cannot be determined. Having regard to the use to which it was put however, and the difficulty in having to accomplish an advanced aerobatic routine smoothly it seems likely that the load limitations were inadvertently exceeded bringing in consequence a reduction in the fatigue life of the structure.

2.2 Conclusions

(a) Findings

(i) The pilot was properly licensed and had considerable experience of aerobatic flying.

(ii) The aircraft had been maintained in accordance with the manufacturer's instructions and was correctly loaded.

(iii) The weather had no bearing on the cause of the accident.

(iv) The centre-section lower front spar boom failed in fatigue when subjected to high loading during an aerobatic manoeuvre.

(v) The pilot demonstrated superb airmanship in successfully executing an emergency landing.

(b) Cause

Following a fatigue failure in the centre-section lower spar boom the port wing deflected upward making it impossible for the pilot to maintain normal erect flight.

R C Warren
Inspector of Accidents

Accidents Investigation Branch
Department of Trade and Industry
July 1971