

## Zlin wing Structural Failure Report

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1970 World Aerobatic Championships, practising at Hullavington

The weather at Hullavington was good, with 2/8 of cumulus based above 3,500ft, 1,066m. The wind was south-easterly, 5kt to 10kt and there was no turbulence.

Because there were three static balloons flying in front of ATC it was decided that we would use runway 05/23 as datum and fly on sorties over the grass parallel to that runway. This would keep us well clear of the balloons and the wind was so light that it did not pose any problems.

Two Zlins were operational that day, with three pilots. I had flown one sortie and took off on the second with full fuel tanks at 11.35 a.m. The sequence was flown twice through satisfactorily, and the aircraft was climbed for the next and final run through. Everything progressed normally until the completion of the fifth figure, which was a vertical climbing half roll, half outside loop to a vertical dive and pull out to level flight at about 1,000ft, 300m. During this pullout, as the nose came up to the level attitude, with 5g indicating. There was a loud bang and a severe jolt was felt through the airframe.

I have heard eyewitness reports in which the aircraft is said to have "staggered". That is perhaps the best way to describe the immediate sensation following the failure. At the same instant there was a sudden and very peculiar increase in slipstream noise, and I found myself leaning against the straps to the left although, as I looked left, the aircraft appeared to be flying level. I had reduced power and centralised controls instinctively at the first signs of trouble.

The reason for the sensation of being pulled to the left was very soon apparent. Although the left wing was flying more or less level, the rest of the aeroplane was rolling left around the failure point. At this stage there was some degree of control over the aircraft, which was by this time beginning to lose height. I throttled fully back to reduce speed and thereby reduce the flight loads, but this caused the nose to drop further. Dihedral was increasing steadily and the roll and yaw to the left were becoming progressively more determined. Full power was then applied in an attempt to get the nose up, but this had no effect at all on the situation. By this time the aircraft was outside the airfield and losing height fast. It was my intention to try to keep the wings as level as possible and to try to achieve a shallow flight path with the intention of arriving, if possible, right way up in the most convenient field available. It was, however, apparent that if control was being lost at that rate, it would have gone completely before reaching the ground. In fact all control was finally lost at about 300ft, 91m.

At this stage the aircraft had turned left nearly 90° from its original heading, and was banked 90° to the left (at least the fuselage was). I thought the wing had folded to about 45° but it was probably less than that, if one takes into account the fright factor. Full right aileron and rudder were being held on and the throttle was wide open as the bank reached 90° left and the nose finally dropped. The sideslip was very high, and the instinctive reaction to pull the stick back only worsened the situation. I had heard a report from Bulgaria some years ago where a top wing bolt had failed on an early mark of Zlin whilst under negative g and that the aircraft had involuntarily flick rolled right way up, whereupon the wing came back into position, and the aircraft was landed by a very frightened, but alive, pilot. I had guessed by this time that a lower wing bolt had failed and that I was faced with a similar situation, albeit inverted.

It seemed that if positive G had saved the Bulgarian, negative G might work for me. In any event, there was nothing else left to try. I centralised the rudder, rolled left and pushed, still with full throttle. The wing snapped back into position with a loud bang, which made me even more concerned for the structure. Immediately the negative G started to rise and the nose started coming up. Altitude was very low by this time and I had no instrument readings at all. For just a moment I thought I was going into the trees, but then the nose was up and the machine was climbing fast, inverted. I was just beginning to think that I might make it after all when the engine died. I checked the fuel pressure - zero. A check around the cockpit revealed the fact that the main fuel cock had been knocked off. This could possibly have been the result of the jolt which accompanied the initial failure. I think I was probably thrown around in the cockpit and may well have accidentally knocked the cock then. I selected reserve fuel and almost immediately realised that this position would take fuel from the bottom of the gravity tank, which was of course now upside down. I therefore re-selected main tank and after a few coughs the engine started and ran at full power.

### Inverted circuit

I was quite low again by this time and initially started to climb straight ahead. I then turned back towards the airfield and continued the inverted climb to 1000ft, 305m. By this time, the remainder of the team had been very quick off the mark and had alerted crash facilities. I throttled back to conserve fuel as I knew the gravity tank was only good for about 8 minutes safe inverted flight. I then turned the aircraft in steady flight and held the stick between my knees (no aileron trimmer) whilst I used both hands to tighten my shoulder harness even more. Had a parachute been carried I would have climbed as high as possible and used it.

I then considered using undercarriage and/or flaps, but rejected both. Flaps were no use to me whilst inverted, and I could not fly right way up anyway. Also if only one flap extended it would cause an immediate loss of control. The undercarriage required more thought. If I could make an inverted approach with a last minute rollout and if the aircraft arrived on its wheels damage might be minimised. However, if the gear fully or partially collapsed the aircraft might turn over. Also, and this was the biggest argument against, the Zlin undercarriage usually extends with a fairly solid thump.

I did not know exactly what damage had occurred and I was concerned in case the strain of lowering the wheels might remove the wing altogether. It was just as well that I left the wheels up, because the failure was not the wing bolt after all, but in the centre section inboard of the undercarriage leg.

I also considered four possibilities for landing, namely, inverted ditching, deliberately crashing inverted into trees to take the impact, inverted crash-landing on the airfield, or an inverted approach with a last minute rollout and hope for the best.

The last seemed to hold the best chances for survival, but I then decided to experiment to see which way was the best to rollout; if the rate of fold of the wing was sufficiently slow it might have been possible to exercise some control over what was obviously going to be a belly landing (I hoped). A rollout to the left was attempted, and the wing immediately started to fold, with the result that the inverted flight was quickly re-established. The rollout to the right was not investigated, as the left wing was obviously being weakened by these manoeuvres. Also the supply of adrenalin was getting rather low by this time.

A wide inverted circuit was made for the grass strip parallel to runway 23. As the crosswind was insignificant this afforded the best approach, clear of buildings and balloons. The threshold was crossed at 112 m.p.h., 180 k.p.h. at about 200ft, 60m with the throttle closed. Petrol and switches were left on in case it was necessary to overshoot; also the canopy was retained, since I did not want my height judgement affected by slipstream. The possibility of a jammed canopy was considered, but the hood is very light, and I felt that I could break my way out if necessary. A slow inverted flare was made and the aircraft was levelled as near to the ground as possible.

Low, low rollout

As the speed fell to 87 m.p.h., 140 k.p.h. a full aileron rollout was made to the right, and just a trace of negative G was maintained in order to hold the left wing in place. The aircraft responded well to the controls at this stage, but as it approached level flight the left wing started to fold up again. The nose was already down as a result of the slight negative G, and subsequent examination of the impact marks showed that the left wing tip touched the ground during the roll, although this could not be felt inside the aircraft. As the wing folded the aircraft hit the ground hard in a slight nose down, left bank attitude. I released the controls and concentrated on trying to roll into a ball, knees and feet pulled up and in, and head down protected by arms. I had a blurred impression of the world going past the windscreen sideways and then with a final jolt, everything stopped. I released the harness, which had done a very good job, and then found that the canopy had sprung 6in, 15cm open and jammed. I didn't bother to investigate this, as the petrol tanks had split! I gave the canopy a resounding blow and it flew open first time. I felt mildly surprised that everything was still working as I evacuated the area, and having decided that the aircraft was not going to burn, and having also collected some semblance of breath and composure, I returned to the aircraft and made all switches safe. The crash services were on the scene very quickly, which was most encouraging. Fortunately they were not required.

The aircraft was a complete write-off, but on reaching into the cockpit and checking the seat, it was as solid as a rock, all the straps were intact, and on moving the control column, both ailerons worked in the correct sense. True, there was a failure, but it is a tribute to the Czech designers and engineers that the aircraft could be flown at all.

It was a nasty experience, but a lot can be learned from it, notably that the aileron was acting as a geared tab, as the wing folded. This resulted in the left aileron being pulled down, since the aileron rods were intact, and as the wing moved, the aileron was applied without any movement of the stick. Any attempt to apply right aileron merely worsened this situation. I could have saved myself a lot of problems by rolling left immediately the failure occurred. It seems also that the damaged wing must be towards the ground during any rolls, either in or out. The ability to fly over an airfield with crash facilities is absolutely essential. This time assistance was not required, but lives have already been saved by this.

This situation may never be repeated but if such an accident does occur again the information in this account may be useful.

I hope it will never be needed.

*From Flight International - 18 June 1970*