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## Tailstrike on landing, Airbus A321-231, G-MIDA, 14 August 1998

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**Micro-summary:** Following the second touchdown in a bounce, the tail of this A321 experienced a tail strike, resulting in a pressurization problem on the subsequent flight.

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**Event Date:** 1998-08-14 at 1118 UTC

**Investigative Body:** Aircraft Accident Investigation Board (AAIB), United Kingdom

**Investigative Body's Web Site:** <http://www.aaib.dft.gov/uk/>

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# Airbus A321-231, G-MIDA, 14 August 1998

**AAIB Bulletin No: 4/2000      Ref: EW/C98/8/8    Category: 1.1**

<b>Aircraft Type and Registration:</b>	Airbus A321-231, G-MIDA
<b>No &amp; Type of Engines:</b>	2 IAE V2533-A5 turbofan engines
<b>Year of Manufacture:</b>	1998
<b>Date &amp; Time (UTC):</b>	14 August 1998 at 1118 hours
<b>Location:</b>	Runway 28, Dublin Airport
<b>Type of Flight:</b>	Public Transport
<b>Persons on Board:</b>	Crew - 10 - Passengers - 191
<b>Injuries:</b>	Crew - None - Passengers - None
<b>Nature of Damage:</b>	Tailscape between frame 63 and frame 68 in the area of the rear fuselage
<b>Commander's Licence:</b>	Airline Transport Pilot's Licence
<b>Commander's Age:</b>	45 years
<b>Commander's Flying Experience:</b>	11,000 hours (of which 180 were on type)  Last 90 days - 131 hours Last 28 days - 50 hours
<b>Information Source:</b>	AAIB Field Investigation

## History of the flight

The crew was rostered for a double rotation Heathrow to Dublin and the accident occurred on the second landing at Dublin. The first officer was the handling pilot and the aircraft was radar vectored onto the ILS to Runway 28 at Dublin. The weather at the time was given as wind 250° at 14 kt visibility 10 km, cloud scattered 1,300 feet broken 2,300 feet, temperature 18° QNH 1007. The approach, which was generally stable, was flown initially on autopilot to about 900 feet and then manually with autothrust engaged. At 120 feet (radio) the aircraft was slightly above the glidepath and the pilot pitched the aircraft down a small amount to correct the flight path. At 80 feet (radio) the power was reduced and at 50 feet (radio) progressive back stick was applied and the aircraft responded with increasing pitch. However, although the rate of descent decreased a hard touchdown resulted from which the aircraft bounced, with the right main landing gear becoming just clear of the ground and the left still just in contact. The crew perceived that the aircraft was

airborne again and the pilot flying kept some back stick applied in order to cushion the landing and the aircraft continued to pitch up.

Almost coincident with the second touchdown the commander pressed his sidestick take over button and applied forward stick. The aircraft pitched down for a normal landing roll out. The pilots were aware that the first landing was hard but they were unaware that the second touchdown resulted in a tailstrike.

They discussed the landing and decided that although a firmer than normal landing had taken place it did not warrant a formal heavy landing check to be entered into the Technical Log. The aircraft was taxied to the stand and the passengers disembarked.

The aircraft was late on arrival and the crew began their turn round checks for the return flight to Heathrow. The cabin crew reported to the commander that the rear crew members had heard a 'clanking' noise in the area of the rear galley. The commander visited the rear galley and after a conversation with the cabin crew he determined that the most likely explanation for the noise was galley equipment moving within its stowage during the firm landing. At the time the operator's procedures did not require the flight deck crew to carry out an external inspection of the aircraft during the turn round at Dublin. This inspection was the responsibility of an engineer supplied by a sub-contractor to carry out the turn round inspection and refuelling.

The aircraft departed for Heathrow slightly behind schedule and the operation was normal until, passing FL 150 in the climb, the crew noticed a high rate of climb in the cabin altitude and the rear cabin crew reported a loud 'whooshing' sound in the rear of the aircraft. The commander levelled the aircraft at FL 170 and, as the cabin altitude was still climbing, a descent to FL 90 was requested. ATC cleared the aircraft to descend initially to FL 110 because of conflicting traffic and, as the cabin altitude had stabilised at 4,200 feet, the commander decided to maintain FL 110 for the cruise. The aircraft made an uneventful landing at Heathrow. An after flight inspection of the aircraft revealed damage consistent with a tailsrape, which included an area of ruptured fuselage skin.

### **Flight recorders**

The Cockpit Voice Recorder (CVR), an Allied Signal A200S was removed and replayed by the AAIB. It had a two hour recording duration, which began prior to the take off at Dublin and covered the subsequent return flight to Heathrow. The landing at Dublin was not recorded, but the longer duration CVR did provide information on the activities on the ground at Dublin and the subsequent return flight.

The Flight Data Recorder (FDR), an Allied Signal Solid State Recorder was replayed by the AAIB. The tailstrike incident was identified from the data as having occurred during the previous landing at Dublin.

During the approach, on the glidepath and with an IAS of 150 kt, the autopilot was disengaged at about 600 feet AGL. The engine power increased, the rate of descent decreased to about 600 feet/min and the aircraft began to drift slightly above the glidepath (maximum deviation 0.5 dots). As the aircraft descended through 400 feet the engine power reduced, the rate of descent increased to about 900 feet/min and the aircraft regained the glidepath.

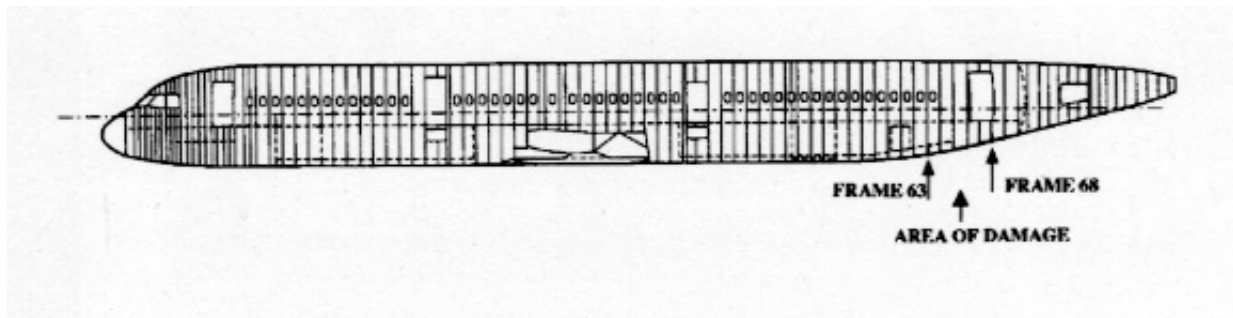
At about 200 feet agl the power increased to 1.15 EPR, the rate of descent reduced to 500 feet/min and the aircraft deviated above the glidepath again; the airspeed was between 146 and 150 kt. Figure 1 shows some of the parameters from 200 feet agl.

At about 80 feet the power was reduced. Four seconds before touchdown, at 52 feet radio altitude, the First Officer's (FO) sidestick began to be moved to demand a nose-up elevator position. The aircraft touched down at a pitch attitude of  $5.3^\circ$  with a normal acceleration of 2.16g. The FO's sidestick position was  $13.4^\circ$  nose-up with an elevator angle of  $11.5^\circ$ . The sidestick demand then started to be moved in a nose-down direction, and the elevator followed. The ground spoilers deployed automatically; this is designed to occur when both the main landing gear oleo switches are compressed. The right main landing gear oleo discrete indicated that the aircraft rebounded slightly.

After the initial touchdown the pitch attitude continued to increase to a maximum of  $10.5^\circ$ . The FO's sidestick position was moving in a nose down demand direction, but was still about  $5^\circ$  nose up. About 0.25 seconds after the maximum pitch attitude the commander then input a nose down demand of  $3^\circ$ . [Note: in the event of simultaneous operation of the sidesticks, the individual outputs are summed together. If the commander operates the override button, the FO's sidestick is isolated. The override operation is recorded on the FDR.] The commander then overrode the FO's sidestick input with a nose up demand of  $11^\circ$  as the nose landing gear of the aircraft lowered onto the runway.

### Damage to aircraft

The fuselage underside had suffered abrasion damage consistent with a tailstrike, in the area indicated in the diagram below.



The fuselage centreline on the underside lies midway between stringer 41 left and stringer 41 right. Laterally the damage extended to stringer 40 on the right side and to halfway between stringers 40 and 39 on the left side, suggesting the aircraft had been banked slightly to the left at the time of the occurrence. This was confirmed by the FDR which showed the right landing gear oleo switch decompress again after the initial touchdown, with the oleo switch remaining compressed on the left hand side. The damage was most severe over frame nos. 64, 65 and 66, where the skin had been completely ground away such that the frames and stringers had also been abraded. A section of skin had become detached from the aft edge of frame 65 such that it was free to flap downwards, thus accounting for the pressurisation difficulties on the subsequent flight from Dublin.

### Discussion

The aircraft had begun to flare at a radio height of 52 feet, some 4 seconds before touchdown. The FO made an initial 7° nose up demand on the sidestick, followed by a 16° (full nose-up) demand. The elevator reached 14° (aircraft nose-up) at the tail strike. The manufacturer's theoretical elevator position was calculated as 15°, using the DFDR parameters (sidestick position, pitch angle and vertical acceleration), which was consistent with the recorded value. The aircraft was descending at a high rate (900 feet/min) 6 seconds prior to touchdown: application of nose up demand by the FO had begun to take effect such that the rate of descent at touchdown had reduced to about 480 feet/min.

After the initial touchdown the aircraft continued to pitch up, resulting in the tail strike on the second touchdown. This was due to a combination of three effects: the pitch up effect of the automatic ground spoiler deployment, the nose-up elevator, which, although the sidestick moved forward, would still produce some nose up demand, and the pitching inertia which had developed during the landing flare.

The manufacturer's data base indicates that there have been 10 tailscrapes involving the A321 since it came into service, almost all occurred during landing. The non-discovery of the damage during the engineer's external inspection for the turn round is difficult to understand. However, there were many items of ground equipment around the aircraft at this time and unless careful attention was paid to the tail area it may be that the engineer was distracted in avoiding activity by ground equipment. Had the damage been discovered then undoubtedly the aircraft would not have departed and it would not have suffered the cabin pressurisation problems encountered on the subsequent sector. The commander's actions after encountering the pressurisation problem were entirely correct in the circumstances.