

Cessna 550 Citation II, CS-DHB

AAIB Bulletin No: 12/2003	Ref: EW/C2003/01/06	Category: 1.1
Aircraft Type and Registration:	Cessna 550 Citation II, CS-DHB	
No & Type of Engines:	2 Pratt & Whitney JT15D-4 turbofan engines	
Year of Manufacture:	2002	
Date & Time (UTC):	27 January 2003 at 2013 hrs	
Location:	Aberdeen Airport, Scotland	
Type of Flight:	Public Transport	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Disintegrated nose wheel, numerous small dents in the fuselage skin and minor damage to right flap	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	52 years	
Commander's Flying Experience:	5,800 hours (of which 930 were on type)	
	Last 90 days - 104 hours	
	Last 28 days - 26 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The aircraft carried out an attempted landing in weather conditions of a gusting crosswind from the left. The aircraft bounced on the first landing and entered a series of divergent bounces, from the last of which a go-around was initiated. During the attempted landing the aircraft sustained damage to the nose landing gear following which it diverted to land successfully at Glasgow Airport where the wind conditions were more favourable.

History of flight

The aircraft was carrying out a positioning flight from Paris Le Bourget Airport to Aberdeen Airport with the co-pilot operating as the handling pilot. The en-route phase of the flight was uneventful and on arrival in the Aberdeen area the aircraft was given radar vectors for an Instrument Landing System (ILS) approach to Runway 34. When the aircraft was established on final approach, the Air Traffic Control (ATC) tower controller issued a landing clearance and reported the surface wind as being from 270° at 23 kt. A further wind check was given about one minute later of 270° at 22 kt gusting 32 kt, which was acknowledged by the crew.

The co-pilot disconnected the autopilot with the aircraft at 250 feet above aerodrome level (aal) and, from about 150 feet aal, held the aircraft in a left wing low slideslip to compensate for the crosswind. The commander reported that the aircraft experienced a downdraft just before landing as a result of which he decided to intervene on the controls in an attempt to prevent a hard touchdown. The aircraft landed on the runway in a slightly nose down and left wing low attitude at a recorded value of 1.6 'g', and bounced back into the air. A second touchdown was made, two seconds later with a nose down pitch attitude of -2.5°, after which the aircraft again bounced. Three further touchdowns were made, each at approximately two second intervals, the last of which was the most severe, recording a nose down pitch attitude of -5.2° and a vertical load of 2.7 'g'. A go-around was initiated by the co-pilot from the final touchdown and the landing gear was retracted. The crew were instructed by the ATC tower initially to climb straight ahead to 3,000 feet and then ATC control of the aircraft was transferred back to the radar controller. The crew requested a holding pattern initially and then, a few minutes later, a second ILS approach.

In the meantime the tower controller realised that an inspection of the runway by a ground vehicle would need to be carried out to check for debris resulting from the attempted landing. During the inspection several pieces of debris, including some parts of wheel rim, were found, one of which had 'CESSNA' stamped on it. The aircraft was instructed to return to the holding pattern and the crew were informed about the debris. When they received this information the crew extended the landing gear again.

The aircraft remained in the hold for some 45 minutes during which time the crew considered their best course of action. They were able to discuss technical issues relating to the landing of the aircraft with possible damage to the landing gear with their company personnel via satellite telephone. They gathered information from ATC about available diversion airports and the weather conditions. They also asked ATC whether any airports had the capability to lay foam on the runway in case they decided to carry out a wheels-up landing. ATC informed them that the nearest available such runway would be at Zurich.

The crew decided to divert to an airport where the wind conditions were more favourable, and after some discussion with ATC, initiated a diversion to Glasgow. On arrival at Glasgow the aircraft carried out a low pass down the runway to enable ground personnel to carry out a visual inspection of the landing gear. This was performed with the aircraft landing lights off and the runway lights at maximum intensity. The ground personnel were able to see enough to confirm that all the landing gear appeared fully down and no major damage could be seen. Based on the information they received, the crew decided that the landing gear should remain down for the landing.

The landing at Glasgow was carried out by the commander at 2153 hrs. The touchdown was normal but as the nose landing gear was lowered to the runway surface it was apparent from the noise and feel that it had been damaged earlier. The aircraft was brought to a stop on the runway centreline with the fire service in attendance. The runway at Glasgow was re-opened at 2247 hrs.

Meteorological conditions

The recorded meteorological conditions at Aberdeen were as follows: at 1950 hrs, surface wind from 260° at 19 kt gusting 31 kt, direction varying between 240° and 300°, visibility 50 km, FEW clouds at 3,000 feet, temperature +5°C/dewpoint -2°C and QNH 1006 mb. At 2020 hrs the recorded surface wind was from 260° at 20 kt gusting 30kt varying between 230° and 290° with the other conditions remaining the same.

The 2020 hrs weather report from Glasgow which was passed to the crew while they were deciding which airport would be most suitable for diversion was as follows: surface wind from 270° at 16 kt, visibility more than 10 km, BROKEN cloud at 3,500 feet, temperature +6°C, dewpoint +3°C and QNH 1013 mb. The main runway directions at Glasgow Airport are 05 and 23.

Aircraft information

The aircraft landing mass at Aberdeen was approximately 11,000 lbs (5,000 kg) with the Centre of Gravity at 27% Mean Aerodynamic Chord; both parameters were within the required limits. The manufacturer's maximum demonstrated crosswind component is 24 kt but this is not considered to be limiting. The operator used 24 kt as the company crosswind limit for the aircraft.

Aircrew information

The commander had several years experience on the aircraft type. The co-pilot had recently converted to the aircraft and had a total of 38 hours on type.

After the accident both pilots separately reported that the first touchdown had been on the main landing gear and that they could recall only two bounces during the landing.

Communications

All relevant ATC transmissions were recorded and available for the investigation. The crew had a facility on the aircraft to communicate directly with their company operations and thereby obtain engineering and operational advice.

Flight recorder information

Cockpit Voice Recorder

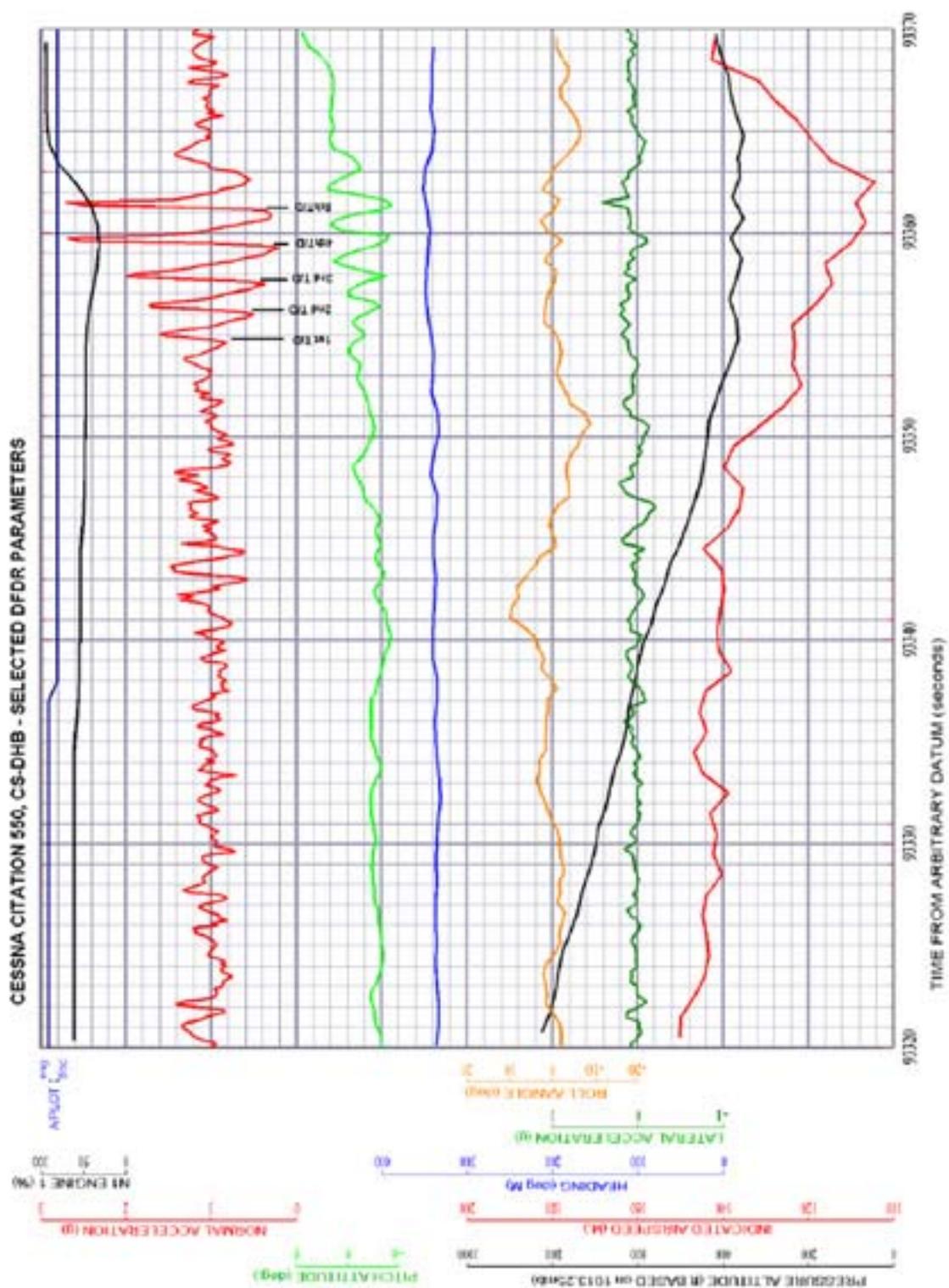
The aircraft was fitted with an L3 Communications 2-hour duration Cockpit Voice Recorder. As the AAIB did not immediately instigate a Field Investigation, the recorder was sent by the operator to a replay agency for downloading of the recorded information. This agency's standard procedure was to copy the last 30 minutes onto a cassette, and then, after checking the recorder's serviceability, to erase the recording. All of this was carried out before the AAIB requested the recorder, so the first 90 minutes of the recordings, which probably contained the landing at Aberdeen, were erased. Consequently, information pertinent to the landing at Aberdeen was not available.

Flight data recorder

The aircraft approached Runway 34 at Aberdeen with the autopilot engaged and a steady descent rate of approximately 720 feet/min. The fluctuations in recorded accelerations indicated that the aircraft was experiencing some significant turbulence. The final stage of flap was selected at about 400 feet above runway level at a speed of about 165 kt. Airspeed then decayed until it reached 140 kt at about 250 feet above runway level, at which point the autopilot was disconnected. The aircraft continued the descent and at 100 feet above the runway and at an airspeed of 135 kt, the pitch angle increased from -3° (nose down) to -0.8° (nose down). The descent rate was arrested somewhat, but pitch reduced again to -3° (nose down) at 70 feet above runway, and the descent rate increased. From this point onwards the pitch angle increased steadily to a slight nose-down attitude at the first touchdown at which point the speed was 124 kt.

Over the period from autopilot disconnect, initially the roll angle increased from generally wings level to 10 degrees right wing down, then reversed over the following 9 seconds to 9° left wing down before returning to about 2° left wing down at first touchdown. At this point the engines N1 RPM had been at 46% but then started to reduce. After the first touchdown, the aircraft went through a series of 'porpoising' manoeuvres and touched down a further four times (five in total). These manoeuvres increased in severity and coincident with the fourth, engine power started to increase from 30% N1. After the fifth touchdown the aircraft left the runway at a minimum recorded speed of 105 kt. It then slowly pitched up, accelerated and climbed away.

A copy of selected FDR (Flight Data Recorder) parameters is shown at Figure 1. On this aircraft, control positions were not recorded, nor were they required to be recorded; therefore, the influence of control movements on the aircraft manoeuvres could not be assessed.



The significant parameters for each touchdown are detailed in the table below. In this table positive pitch is nose up, positive roll is right wing down, and positive lateral acceleration is to the right.

Touch down	Time Reference	Air Speed	Pitch	Roll	Peak Normal Acceleration	Peak Lateral Acceleration
1	93354.75	124 kt	-0.7 deg	-1.8 deg	1.6g	0.18g
2	93356.13	118 kt	-2.5 deg	+1.8 deg	1.7g	0.2g
3	93357.63	114 kt	-2.3 deg	-0.6 deg	2.0g	0.16g
4	93359.38	110 kt	-4.0 deg	-2.3 deg	2.67g	-0.11g
5	93361.13	108 kt	-5.2 deg	-0.3 deg	2.7g	0.41g

Engineering investigation

Photographs taken after the aircraft landed at Glasgow showed that the nosewheel rim was missing but the deflated tyre was still held in the fork of the NLG (Nose Landing Gear) strut. After replacement of the nosewheel the aircraft was ferried unpressurised to Bournemouth Airport for repair assessment. It was at this location that the aircraft and the wheel were examined by AAIB.

Damage to the airframe principally involved numerous small dents in the fuselage skin aft of the NLG, clearly caused by impacts from the broken pieces of rim. There was also a small area of damage to the fibreglass skin of the right flap. Inspection did not reveal any areas of structural damage to the NLG or its attachments.

The wheel debris recovered from Aberdeen mainly comprised about 17 pieces of the left and right rims. Significantly, they bore no signs of abrasion from the runway but each piece had distorted prior to separation. In addition, there were no signs of any pre-existing cracks or defects. The tyre, although scuffed in several areas, was intact and did not appear to have burst, rather having deflated due to the rim failure. The rest of the wheel had suffered abrasion damage due to contact with the runway at Glasgow.

The wheel and tyre were submitted by the aircraft operator to their manufacturer for further examination. The manufacturer's analysis also concluded that there were no pre-existing defects and that the rims had failed due to 'some type of impact with a foreign object'. When asked whether such a 'foreign object' could include the ground itself, the manufacturer agreed that it could (it did not appear that they were appraised of the circumstances of the accident when conducting the examination).

It is almost certain that the nosewheel rims broke-up due to one or more of the impacts suffered during the attempted landing at Aberdeen. The subsequent landing at Glasgow with the tyre deflated caused further abrasion damage to the remains of the wheel

Discussion

The steady wind on the approach was from 260°M to 270°M at 23 kt, some 70° to 80° off the runway direction of 343°M. Therefore the reported surface wind conditions were within the demonstrated 24 kt crosswind capability of the aircraft. However, the wind was varying considerably in both direction and strength which gave rise to the undoubtedly gusty conditions. The gusts, together with the crosswind component from the left, probably caused the destabilisation in the landing phase which concerned the commander to the extent that he felt he needed to intervene on the controls. He was not however able to prevent the first firm touchdown.

After the first touchdown the aircraft bounced and entered a series of divergent bounces, typically seen as a result of crew inputs in an attempt to control a bounced landing. The crew could only recollect two bounces, perhaps indicating that they both became confused during the sequence of events. Although the co-pilot was the handling pilot for the landing and go-around, it is not clear which of the pilots had overall control of the aircraft between the first touchdown and the go-around. The lack of clarity at this stage may account for the length of time that elapsed before a positive go-around decision was made. Each bounce was spaced at approximately two second intervals, giving an elapsed time of some eight seconds after the first bounce before the decision to go-around.

Following the go-around the crew were intending to carry out another approach at Aberdeen. It was only when they received the information from ATC about the debris on the runway that they realised that the aircraft may have been damaged. After receiving the reports of debris the crew decided to continue in the hold and consider their options. The aircraft had sufficient fuel on board to be able to hold for at least an hour. They decided to burn off fuel to a minimum reserve level before attempting a landing. During this time the crew used all the resources available to them to consider their best course of action.

The crew could not be sure which part of the landing gear was affected or how severe the damage might be. The gear had retracted normally during the go-around and extended normally again later. Following discussion with their company operations, the crew considered the possibility of a wheels-up landing and with this in mind, they asked whether it would be possible to lay foam on a runway prior to their landing. However, the previous practice of laying down 'foam carpets' prior to the landing of aircraft with landing gear problems is no longer undertaken in the UK and ATC correctly informed them that the nearest available location would be Zurich.

The low-level flypast along the runway carried out at Glasgow provided information to the crew that all three landing gears were down. Using this information the crew decided to carry out a landing with the gear extended and the damage sustained whilst landing at Glasgow was minimal.