

Cessna 560 Ultra, VP-CKM

AAIB Bulletin No: 9/99 Ref: EW/C98/9/2 Category: 1.1

Aircraft Type and Registration:	Cessna 560 Ultra, VP-CKM
No & Type of Engines:	2 Pratt & Whitney JT5D-5A turbofan engines
Year of Manufacture:	1997
Date & Time (UTC):	26 September 1998 at 0703 hrs
Location:	Fairoaks Airport
Type of Flight:	Private
Persons on Board:	Crew - 2 - Passengers - 1
Injuries:	Crew - 2 minor - Passengers - Nil
Nature of Damage:	Landing gear torn off, left wing tip removed, extensive impact damage to fuselage underside, wings and tail. Heavy ingestion damage to right engine
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	14,500 hours (of which 400 hours were on type) Last 90 days - 144 hours Last 28 days - 33 hours
Information Source:	AAIB Field Investigation

History of flight

The crew left Sheffield in VP-CKM at 0622 hrs for their flight planned destination of Fairoaks with London Heathrow Airport as an alternate. By 0650 hrs they were in contact with the Aerodrome Flight Information Service Officer (AFISO) at Fairoaks but the AFISO advised the crew not to land until the normal operating time at 0700 hrs when the airfield would have fire cover available. The current weather was reported to the crew by the AFISO as follows: Sky clear; mist with a visibility of 1,200 metres; surface wind 060° less than 5 kt; QNH 1002 mb and QFE 1005 mb. The commander, who was the handling pilot, approached the airfield on a track of 060° using the Fairoaks Non-directional Radio Beacon (NDB) and the aircraft's Flight Management System (FMS), and descended to 1,000 feet agl with the intention of landing on Runway 06. However, neither pilot saw the airfield until they were overhead and, in agreement with the AFISO, decided

to make an approach to Runway 24 because of better visibility in that direction. The AFISO switched on the Abbreviated Precision Approach Path Indicators (APAPIs) for Runway 24 and the commander flew a tear drop pattern to the east of the airfield and then established the aircraft on a track of 240° towards the airfield. During the pattern, the gear had been selected down and the flaps set to an intermediate position. At 1.8 nm DME range, the co-pilot saw the APAPIs slightly left of the aircraft nose and pointed them out to the commander; at the time, the co-pilot recalled that the APAPIs were showing 'two whites', the aircraft was at 1,000 feet agl and at 124 kt IAS. By now, the crew had been advised to land at their discretion with the wind calm. Subsequently, full flap was selected and the commander noted his speed on short finals as 104 kt. As VP-CKM approached the threshold, the commander called for the deployment of speedbrakes; as the co-pilot deployed the speedbrakes, he noted the DME range as 0.5 nm and that the FMS indicated a tailwind of 5 kt. The commander considered that touchdown was positive and just beyond the threshold; the co-pilot considered that touchdown was just past the APAPIs.

Immediately after touchdown, the commander selected full thrust reverse on both engines and applied moderate wheel braking. Initially, he considered that the retardation seemed adequate but then seemed to reduce. The co-pilot was not aware of retardation and remembered applying maximum brake pedal pressure while noticing that the runway was damp and seemed "shiny". When he realised that he could not stop the aircraft before the end of the runway, the commander stowed the thrust reversers and attempted to close down the engines. During the later part of the landing run, the co-pilot heard a call of "going round" and saw the commander stow the thrust reversers.

After leaving the runway, the aircraft travelled for 250 metres before coming to rest. The passenger evacuated through the cabin escape hatch and the co-pilot followed him after an unsuccessful attempt to open the normal cabin door. The co-pilot was then able to open the cabin door from the outside and assist the commander to leave. The commander had sustained back injuries and the co-pilot had received some cuts and bruises.

On seeing the aircraft going off the runway, the AFISO alerted the AFS who, because of the misty conditions, had positioned at the threshold of Runway 24. The AFS followed the track of VP-CKM and on arrival at the crash scene, where there was a strong smell of fuel with smoke emanating from the engines, covered the aircraft with foam. The AFS moved the aircraft occupants well clear of the wreckage and remained on the scene.

Eyewitness accounts

The AFS personnel considered that the aircraft had touched down approximately 1/3 of the way down the runway. A subsequent interview with the AFISO and calculations of his line of sight of where the aircraft touched down, indicated that touchdown was approximately 380 metres beyond the threshold.

Other eyewitnesses were interviewed and all were of the opinion that the aircraft seemed to land further down the runway than aircraft normally did. One of the eyewitnesses, who is an aircraft engineer, confirmed that he could see the thrust reversers deployed during the ground roll.

Recorded information

VP-CKM carried a two hour duration cockpit voice recorder (CVR); the entire accident flight was recorded. Additionally, London Air Traffic Control Centre (LATCC) provided recorded radar data

from three sources. This information was combined and used to calculate the aircraft track, altitude and groundspeed. There was no requirement for the aircraft to be fitted with a Flight Data Recorder. The flight appeared uneventful prior to initial contact with Fair Oaks.

The aircraft approached Fair Oaks from the south-west and when the commander reported that he had the field in sight, the AFISO reported the wind as: "080° less than 5 kt". The commander carried out an orbit to the north and then made an approach to RW 06. The crew were unable to see the runway in time and decided to: "Try two four".

Fifty five seconds before touchdown on RW 24, the commander reported that he had: "two and a half miles to run". The AFISO replied: "wind calm land at your discretion". Thirty two seconds before touchdown, the co-pilot called that he could see the APAPIs. The commander then called: "full flap". Thirteen seconds before touchdown, there was a single GPWS 'sinkrate' warning. Immediately after this, the commander called: "speedbrake now"; the co-pilot replied: ".. brakes out".

The CVR cockpit area microphone channel indicated a firm landing. Reverse thrust was selected 1.3 seconds after touchdown and was heard to deploy less than one second later. Reverse thrust was maintained for three seconds before being deselected, coincident with the commander calling: "we're going round". There was no subsequent audio indication of the power levers being advanced, or of engine power increasing. Eleven and one half seconds after touchdown, the CVR recorded sounds consistent with the aircraft wheels leaving the runway paved surface. Immediately prior to this, the AFISO transmitted: ".....threshold it's an overrun overrun overrun". The CVR recording ended 11.5 seconds after the aircraft left the paved surface.

Using the recorded radar data, correlated with the CVR, the average groundspeed speed on the approach to RW 24 was calculated as 133 kt. The recording frequency of the radar data made it difficult to determine accurately the deceleration following the deployment of full flap and the airbrake before touchdown. The best estimate using recorded data is that the speed at touchdown was between 105 and 115 kt. Using this spread of speeds and typical runway performance data for the aircraft type the touchdown point was determined to be between 1/4 and 1/2 way in from the runway threshold. From correlation of the sounds on the CVR and the physical objects on the subsequent ground roll, it was estimated that the speed as the aircraft left the paved surface was between 40 and 50 kt.

Performance information

The commander stated that, prior to flight, he had checked the aircraft performance and found that Fair Oaks was 30 to 40 metres longer than that required with no tail wind, at the expected landing weight. He also confirmed that the FMS showed the landing weight as 13,800 lb, which equated to a threshold speed of 103 kt and an approach speed of 109 kt. Subsequent calculations confirmed that this landing weight was accurate.

The crew were using Jeppesen charts which showed that the APAPIs were set at 3.5°. The landing chart showed the landing distance for Runway 24 as 2,625 feet (800 metres) and that for Runway 06 as 2,541 feet (777 metres).

The aircraft was required by its State of Registration to operate in accordance with the information contained within the aircraft Flight Manual (FM). The landing distance figures are based on a dry runway with full flap but with no allowance for thrust reversers; the figures show the distance from

a screen height of 50 feet to a full stop with the speed brakes deployed immediately after landing. In zero wind conditions, the distance required at 13,500 lb is 2,500 feet (762 metres) and at 14,000 lb is 2,590 feet (789 metres); interpolation for 13,800 lb results in a landing distance required of 2,554 feet (778 metres). For a wet runway, defined in the FM as less than 0.01 inch of water, these figures must be multiplied by 1.45. For FAR 135 Operations (USA Air Taxi Operations equivalent to UK Public Transport Operations), the crew is required to divide the figures contained within the Flight Manual by 0.6. The aircraft's State of Registration did not require that performance data be factored for private operations. Within the UK, the CAA strongly recommends that commanders on private flights apply the same safety factors as those legally required for Public Transport flights. General Aviation Safety Sense Leaflet 7B advises that a safety factor of 1.43 be applied to the required landing distance.

Operational information

The commander was familiar with Fairoaks Airport and estimated that he had landed there at least 20 times and at least 6 times in Citations of various marks. This was his first landing at Fairoaks in the 560 Ultra although he stated that he had landed the aircraft at several airfields with runways of similar lengths.

The APAPIs for Runway 24, which are positioned 142 metres from the threshold, had been checked using a clinometer on 16 September 1998 and was subsequently checked after the accident. It was noted that the inboard light colour changeover between red and white occurred at 4° and that the outboard light changeover occurred at 3.5°; this would give an approach path of 3.75°. This was at variance with the information contained on the Jeppesen charts and within the UK Aeronautical Integrated Publication (UK AIP). The angle of the PAPI's has since been adjusted to correspond with the published 3.5°.

The Flight Manual contains the following warning: 'Do not attempt to restow reversers and take-off once reversers have started to deploy'.

Engineering investigation

The aircraft came to rest 250 metres beyond the end of Runway 24. Very faint tyre marks, identifiable with the aircraft, could be seen on the runway hard surface where the aircraft had left the runway and these were continuous with marks on the grass. Backtracking on the runway itself, these marks faded within 20 or 30 metres and could not be followed further back. The wheel marks on the hard surface were slightly lighter than the surrounding surface and there had been no rubber transfer which could indicate heavy braking. There was no sign of the distinctive marks on the runway which can result from anti-skid operation. Similarly, the marks on the grass were relatively light; grass had been crushed but there was no indication of skidding. When the aircraft left the runway it had been astride the centreline and accurately aligned with the runway.

The aircraft passed through three small paddocks before coming to a halt in an open field. It went through five fences or hedges and over three ditches. The landing gear collapsed at the first field boundary which comprised a ditch and a hedge and the aircraft slid for the remaining distance on its belly veering to the left as it did so. Its final impact was with a hedge and a ditch which was embanked; after crossing this ditch, the aircraft came to rest yawed 90° to the right.

The thrust reversers and speed brakes were found stowed. In the cockpit the anti-skid selector switch was found in the "ON" position, the flap selector lever was at 'LAND' (35°), and no relevant

circuit breakers had actuated. The emergency brake handle was stowed. The left throttle lever was at "SHUT OFF" and the right at "IDLE".

The mainwheel tyres showed no damage indicative of skidding or aquaplaning. Most of the fluid in the hydraulic system had been lost but the accumulator pre-charge pressure was seen to be within limits. Because the landing gear had been torn off, the braking system could not be tested as a whole. The brake control system components were removed; some were tested by the AAIB, and the manufacturers with FAA participation tested others in the USA. All were found to operate successfully with no significant defects.

Runway friction evaluation

Following the accident, the AAIB contracted the Airfield Operations Safety Unit of BAA Heathrow to carry out runway friction tests at Fairoaks Airport. Test runs were carried out on Runway 06/24 on 29 October 1998 when the runway was dry; the machine used was a Griptester GT008 and was towed at a speed of approximately 60 km per hour and using a self-wetting depth of 0.25 mm. Measurements of friction coefficients were recorded over each third of the runway's length and at 2 metres spacing across the runway. These averaged 0.86 with a minimum of 0.79. Notice to Aerodrome Licence Holders (NOTAL) No 2/94 gives "above 0.8" as the design objective for runway friction coefficient (as measured by the "Griptester" equipment used here). It also gives 0.63 as the "Maintenance Planning Level" and 0.52 as the minimum level below which a runway should be notified as "slippery when wet".

Discussion

Investigation indicated that there was no technical reason for the aircraft to overrun the runway. One factor outside the crew's control was that the APAPIs were not set at the glideslope angle described in the Jeppesen approach charts. However, the error was one quarter of one degree and should not have affected the touchdown point of the aircraft. Additionally, the crew stated that the APAPIs showed 'two whites' when first acquired and made no mention of them during the approach; it seems likely that the commander was flying his approach to land close to the threshold.

Prior to departure, the commander checked the landing distance required for the expected weight of VP-CKM at Fairoaks and calculated that he had 30 to 40 metres longer than required based on zero surface wind. This calculation was subsequently confirmed as reasonable for a landing on Runway 24. However, the initial approach into Fairoaks was for Runway 06 which has a landing distance some 53 metres less than Runway 24. Therefore, the landing distance available on Runway 06 was less than that required by the Flight Manual by at least 13 metres.

The commander was unable to land on Runway 06 because of the into sun visibility and so landed on Runway 24. For the approach to Runway 06, the surface wind was reported as 060° less than 5 kt and, for the subsequent approach to Runway 24 the surface wind was reported as calm. The landing distance available on Runway 24 was more than that required by the Flight Manual on a dry runway with no wind. However, the reported surface winds indicated a possibility that the aircraft could experience some tail wind component during the landing and the co-pilot also noted that the FMS displayed a tailwind of 5 kt as he deployed the speedbrakes. The presence of mist could indicate a runway surface other than dry and the co-pilot also noted that the runway was damp and seemed "shiny". Against these factors, the commander would have considered the added advantage of using thrust reversers. Nevertheless, since the commander was not applying any recommended safety factors, it would have been prudent for him to ensure that his approach and

touchdown were accurate. He considered that his speed was close to that required as he approached the threshold and that the landing was just beyond the threshold. However, the co-pilot considered that the touchdown was just past the APAPIs positioned 142 metres from the threshold. Outside observers noted the touchdown as between 1/3 and 1/2 way down the runway and this view was corroborated by calculations from the CVR and radar information. The speed on touchdown, as assessed from the recorded information, was close to that required.

From touchdown to leaving the paved runway surface, took a period of 11.5 seconds. Thrust reverse was used for three seconds and deselected some 6 seconds before the aircraft left the runway. As thrust reverse was deselected, the commander called "we're going round". This would indicate that the commander became concerned during his landing roll that he would not be able to stop in the distance available and deselected thrust reverse in preparation for a Go-Around. However, the Flight Manual warns that a Go-Around should not be attempted once thrust reverse has been selected. Since there was no evidence from the CVR that power was subsequently advanced, it seems likely that the commander immediately decided against this option. However, the action of deselecting thrust reverse reduced the aircraft rate of deceleration as the runway end approached and resulted in a longer overrun. The commander subsequently stated that he cancelled reverse thrust to enable him to shut down the engines and reduce the risk of fire in what was, by then, obviously going to be an overrun.

The actions of Air Traffic and AFS personnel were prompt and effective.