Hard landing, ATR 72-212A, D-ANFH, September 17, 2005

Micro-summary: **This ATR-72 landed hard.**

Event Date: **2005-09-17 at 1202 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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ACCIDENT

Aircraft Type and Registration:	ATR 72-212A, D-ANFH
No & Type of Engines:	2 Pratt and Whitney PW127F turboprop engines
Year of Manufacture:	2001
Date & Time (UTC):	17 September 2005 at 1202 hrs
Location:	Guernsey Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 63
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to lower rear fuselage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	10,000 hours (of which 517 were on type) Last 90 days - 110 hours Last 28 days - 41 hours
Information Source:	AAIB Field Investigation

Synopsis

Just prior to touchdown, in good visual meteorological conditions, the co-pilot deliberately flew the aircraft below the glideslope, as he perceived the runway to be short. The approach was de-stabilised and the aircraft landed heavily and bounced, during which the lower rear fuselage struck the runway. The investigation identified that the landing technique employed was incorrect and that the runway length was more than adequate for the aircraft to make a normal landing in the prevailing conditions.

History of the flight

The aircraft departed from Düsseldorf on a non-scheduled public transport (passenger) service to Guernsey, with the co-pilot as Pilot Flying (PF) and the commander as Pilot Not Flying (PNF). Prior to the top of descent, following an uneventful flight, the crew obtained the ATIS broadcast, which included the information that Runway 27 was in use, there was a surface wind of 020°/11 kt, the visibility was in excess of 10 km and there was cloud FEW at 3,800 ft above the aerodrome. They prepared and briefed thoroughly for an ILS approach to Runway 27; the landing weight was calculated to be 20.7 tonnes and the approach speed (V_{APP}) 107 kt (V_{REF} plus 5 kt).

Guernsey ATC vectored the aircraft towards the final approach track, at an altitude of 2,000 ft, and offered the crew the opportunity to carry out a visual approach, which they declined. The aircraft intercepted the

glideslope with the landing gear extended and Flaps 30 set. At approximately 500 ft above the runway, the co-pilot remarked to the commander that he intended to manoeuvre slightly below the glideslope; the commander acknowledged this with a remark which suggested that this had been briefed. (The co-pilot later stated that Guernsey was one of the shorter runways onto which he operated the ATR aircraft and, typically, the route network focussed on major airports with significantly longer runways than Guernsey. He explained that his decision to deviate below the glideslope reflected his relative lack of experience in landing on shorter runways.) The co-pilot then reduced power and the aircraft began to descend below the glideslope. Throughout the approach, the aircraft's speed varied between 110 kt and 127 kt, reducing to 100 kt at the point of touchdown. Just prior to touchdown, the co-pilot pitched the aircraft nose up to an attitude of 6.5º. The aircraft landed hard on the runway and bounced; in the course of the initial touchdown, the lower rear fuselage struck the runway surface. The commander later recalled that there had been 'no flare' and that, although he had been 'guarding' the controls, he had not had sufficient time to take control and prevent the heavy landing.

The crew completed the landing and taxied to their parking position. After the aircraft had been shut down, ground staff informed the commander that the aircraft had been damaged.

Personnel information

The commander and co-pilot had flown together previously and were well acquainted with each other.

The commander was an experienced pilot with a total of 10,000 flying hours and, although he was relatively new to the ATR aircraft, he had previously flown the Shorts SD3-60 aircraft and the Fokker 50, types powered by turboprop engines and of comparable size to the ATR. The commander was on the fourth day of a series of duties, the previous three days being two-sector short-haul flights in the afternoon and evening. The commander did not suggest that he was fatigued during the duty period, and his duty record over the previous days showed a relatively undemanding work pattern with plentiful rest periods during the nights.

The co-pilot was also relatively experienced, with 4,000 hours total time and previous experience on the Fokker 50 aircraft, but was relatively inexperienced on the ATR, with 500 hours on type. He had returned to Germany two days before the accident following two weeks holiday in the United States of America. The day before the accident, he flew four sectors and reported that, although he had slept a little longer than usual prior to reporting for duty for the flight to Guernsey, he was well rested and fit to fly.

Operations manual (OM)

The company's OM included the following instructions regarding the requirement for stabilised approaches:

> *'3.10.4 Aeroplane Stabilization on Final Approach*
>
> *A safe flight profile must be maintained throughout every approach. The aeroplane must be fully stabilized not later than 1000 ft above threshold elevation including the following criteria:*
>
> - *The aircraft is on the correct flight path;*
> - *Only small changes in heading/pitch are required to maintain the correct flight path;*
> - *Power setting is appropriate for the aircraft configuration and is not below the minimum power for approach as defined in the OM-B…'.*

The following instruction was included concerning landing:

> *'3.11.2 Height over Threshold*
>
> *The height of the aeroplane over the landing threshold should be not lower than 50 ft, except when published otherwise in OM-C. The aeroplane has to cross the landing threshold in the correct configuration and attitude.*
>
> *3.11.3 Touchdown*
>
> *Touchdown should be achieved at 300 m beyond the threshold.'*

Landing performance

Given the conditions at Guernsey, the aircraft weight at the time of landing and allowing for a tailwind component of 5 kt, the Landing Distance Required (LDR) was 949 m. The Landing Distance Available (LDA) was 1,453 m.

Meteorological information

Terminal Aerodrome Forecasts (TAFs), Meteorological Actual Reports (METARs), and a dynamic recording of the measured wind at Guernsey were obtained for the period covering the flight. The Guernsey TAF for the period predicted wind of 030°/12 kt, visibility greater than 10 km, and cloud SCT at 3,000 ft. The 1150 hrs METAR was broadcast on the ATIS as Information Bravo, and stated that the wind as 020°/11 kt, varying between 340° and 050°, visibility greater than 10 km, cloud FEW at 3,800 ft, temperature of +14 °C, dew point +4°C and the QNH 1027 mb. Runway 27 was in use.

Examination of the aircraft

The aircraft's fuselage skin directly beneath the rear cabin door had been abraded, as a result of runway contact, over a length of approximately 0.9 m and a width of some 0.5 m. This had affected fuselage Frame Nos 36 to 38, with the skin having worn through to the extent that the flanges of Frames 36 and 37 were exposed. The damage was symmetrical about the aircraft centre line, indicating that the aircraft was in a wings level attitude at the time it initially touched down.

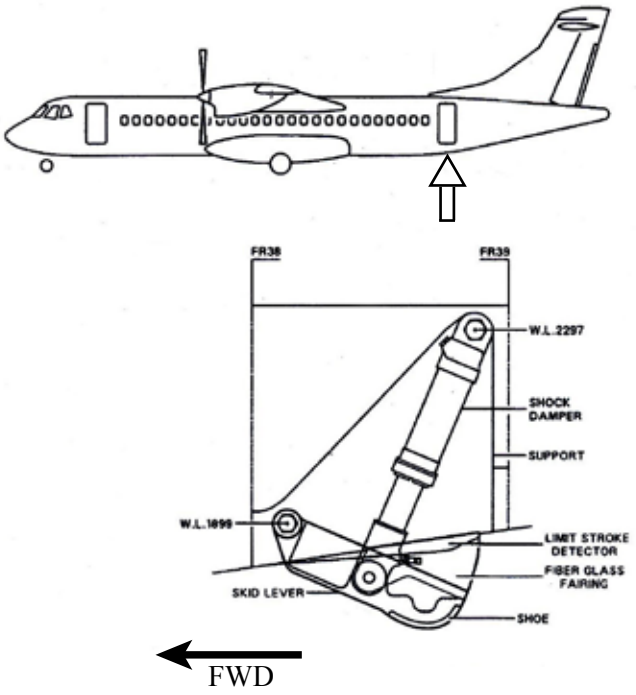
The aircraft was equipped with a tail skid, located between Frames 38 and 39, which comprised a skid lever, hinged at its forward end, and an oleo-pneumatic strut (shock damper) attached to its aft end. A steel shoe was attached to the underside of the lever; this had been painted red in order to provide readily visible evidence of skid contact. It was evident that both the shoe and front edge of the skid lever had suffered severe abrasion, with no trace of red paint remaining on the shoe. According to the aircraft Maintenance Manual, the installation was designed to:

> *'avoid fuselage contact with the runway when the take-off or landing attitude has an angle of 8° or greater.'*

The shock damper had a stroke of 112 mm and, when fully compressed, the forward edge of the skid lever was virtually parallel to, and slightly proud of, the fuselage skin. Two small fins are attached to the fuselage, one each side of the skid; these serve as 'limit strike detectors' and, on D-ANFH had been worn away. Figure 1 shows the damage to the fuselage and skid, together with a diagram of the skid components.

Runway examination

Inspection of the runway the following day revealed a significant scrape mark, some 75-80 mm wide, starting approximately 35 m after the Runway 27 designator numerals; this was around 95-100 m beyond the start of



ATR 72 Tail skid detail

Abrasion damage on fuselage underside

Figure 1

the paved area and 60 m before the first of the touchdown zone markings. The scrape was immediately adjacent to the runway centre line and the presence of red paint strongly suggested that it had been made by the tail skid of D-ANFH. The mark was approximately 9 m in length, with a wider portion extending to some 0.4 m in width along the direction of travel, where the fuselage underside ahead of the skid had also made contact with the runway surface.

Flight Recorders

The aircraft was fitted with a Solid State Flight Data Recorder (FDR) capable of recording a range of flight parameters into solid state memory. The aircraft was also fitted with a Cockpit Voice Recorder (CVR) which recorded crew speech and area microphone inputs, also into a solid state memory. Both recorders were downloaded at the AAIB and data and audio recordings were recovered relating to the subject flight, approach and landing.

The CVR had recorded the entire flight. Much of the conversation between the flight crew was in German, and a German-speaker was employed to assist with the analysis. Although the recording was of good quality there was a period, shortly after the briefing for the approach to Guernsey, during which a PA announcement by one of the cabin crew rendered the conversation between the pilots inaudible[1].

A time-history of the relevant parameters from the FDR during the approach and landing is shown at Figure 2. The data presented starts just over three and a half minutes before the touchdown with the aircraft in level flight at an altitude of approximately 1,800 ft, whilst flying at an airspeed of 175 kt and with the flaps and landing gear up. Some 30 seconds later, Flap 15 was selected and the aircraft turned to the left through 34º, to 275ºM, on to an intercept with the Runway 27 localiser. Height and speed remained unchanged.

At just over two minutes before touchdown, the landing gear was selected down and the airspeed started to reduce. Thirty seconds later, Flaps 30º was selected with the airspeed still reducing. By now, both the glideslope and localiser had been intercepted and a descent was initiated at approximately 700 fpm, based on radio height above the sea. The aircraft was initially above the glideslope, but regained it within a minute as the aircraft passed through 1,500 ft, with an airspeed of 120 kt (13 kt above V_{APP} (107 kt), 18 kt above V_{REF} (102 kt)).

The aircraft remained on the glideslope, during which time the airspeed increased to 135 kt, then reduced to 110 kt, before increasing again to 118 kt, with corresponding changes in pitch and power, until it was at a height of approximately 500 ft, some 15 seconds before touchdown. The aircraft was then manoeuvred below the glideslope, with an initial 5º decrease in pitch attitude to -4º. This caused the airspeed to increase to 124 kt and, as the aircraft was pitched up to 0º, the torque on both engines reduced from 29% to 3%, then increased to 12%, following which the airspeed reduced to 107 kt (V_{APP}).

The flare began two seconds before the main wheels touched down, and the aircraft's pitch attitude increased to the maximum (recorded) value of +6.5º. At this time, the engine torque reduced from 12% to 3%. The recorded airspeed and vertical acceleration at touchdown were 100 kt (V_{REF} -2) and 2.7g, respectively, with the main then nose gear squat switches signifying ground 'contact', over one second later.

Analysis

There was no doubt that the damage to the aircraft was consistent with the fuselage making contact with the runway, heavy enough to cause the tail skid damper to compress to its full limit of travel. The loss of material from the skid's shoe allowed the fuselage structure to contact the runway surface and be abraded. This was as a direct result of an excessive pitch attitude during the landing.

Footnote

[1] PA announcements are recorded on the same channel as the flight deck conversation

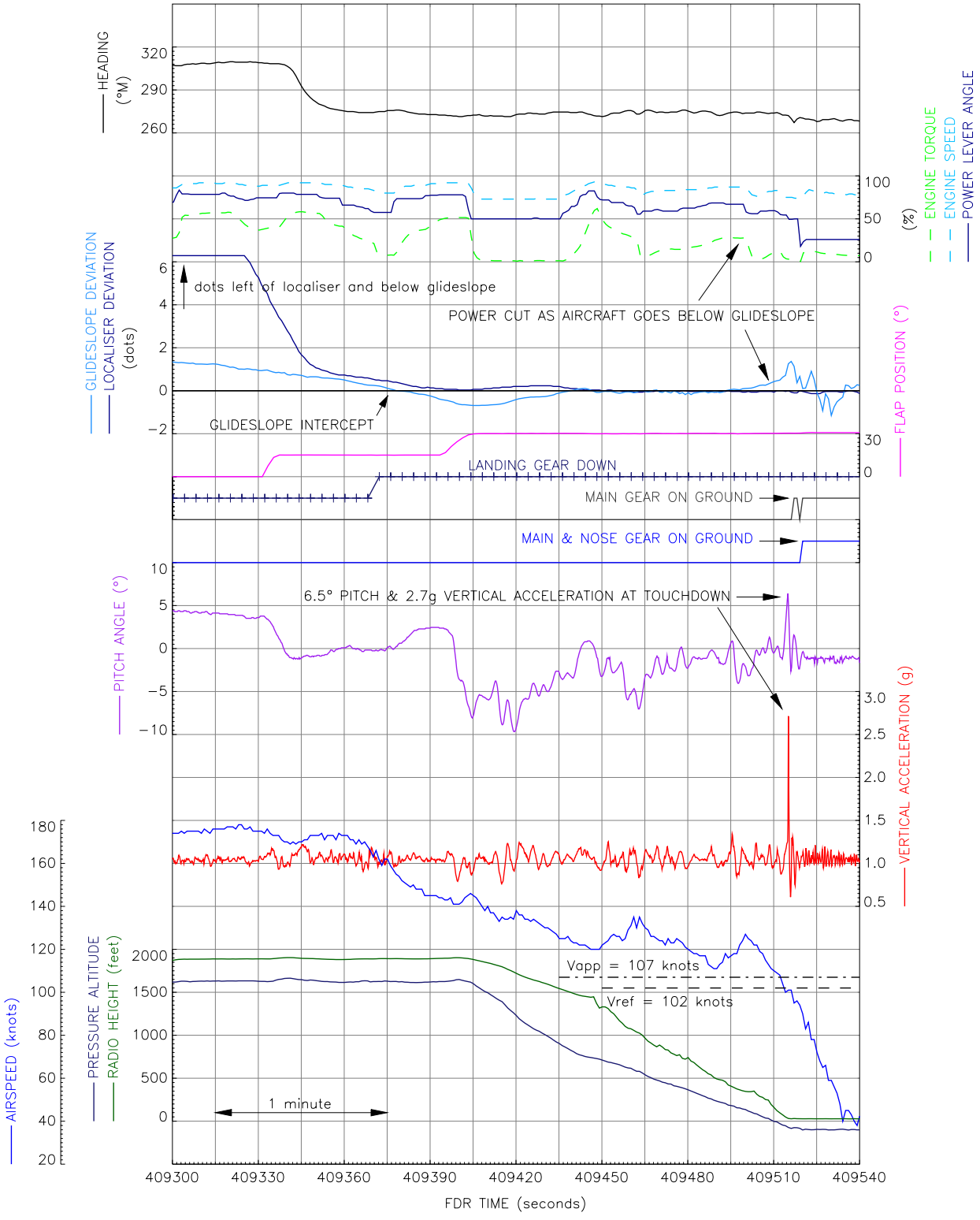


Figure 2

Salient FDR Parameters – Approach and Landing

(Accident to D-ANFH on 17 September 2005)

The flight from Düsseldorf had progressed normally until the aircraft began to descend on approach to Runway 27 at Guernsey Airport, where a fully stabilised approach was achieved, until the aircraft was deliberately manoeuvred below the glideslope. This was not necessarily cause for a go-around but should, perhaps, have given the commander reason to pay particularly close attention to the co-pilot's actions. The Operator's OM requires pilots to fly stabilised approaches, which is the generally accepted practice in the operation of Commercial Air Transport aircraft, and also gives instructions regarding the manner in which the aircraft should be landed. Specifically, it states that the aircraft should cross the threshold at the correct height, in the correct configuration and in the correct attitude. The approach and landing at Guernsey did not meet this OM criteria.

It could not be established from the recorded data whether the decision to deliberately descend below the glideslope in the last moments before touchdown had been discussed during the crew's briefing for the approach. In response to the co-pilot's comment to the commander that he intended to manoeuvre slightly below the glideslope, the commander responded with words which suggested that this deviation had been briefed, although no such discussion was identified on the CVR. However, it is possible that the record of any such conversation was rendered inaudible by a PA announcement made by one of the cabin crew. If the co-pilot had indeed briefed his intention to deviate from the glideslope, then it might have been expected that the commander would have explained that this was unnecessary and inappropriate, and have instructed the co-pilot to fly a normal approach, or elect to carry out the landing himself.

Even with the slight tailwind component, the LDA was significantly greater than the LDR, and both he and the commander should have understood that application of the correct landing technique would assure a safe landing, with a considerable margin. Although the tailwind component and the co-pilot's lack of experience of landing on relatively short runways seem to have played a part in his decision to deviate from the normal landing technique, making such a decision would not have featured in any of his, or the commander's, training.

Aircraft are certificated to certain performance standards, based upon the design/characteristics of the aircraft, the results of flight testing and the application of safety factors to ensure that intended operations will not hazard aircraft. Landing performance is predicated upon the application of the correct technique. Deliberate deviation from the correct technique is unnecessary, except perhaps in extreme and unforeseen circumstances, and deprives the operation of the safety margins that certificated performance provides.