
Collision with edge lights on takeoff, Serious incident on March 5, 2002 at Dresden Airport involving an Aerospatiale ATR-72-212i.

Micro-summary: On takeoff, the ATR-72 collided with runway lights.

Event Date: 2002-03-05 at 2033 local

Investigative Body: Federal Bureau of Aircraft Accidents Investigation (BFU), Germany

Investigative Body's Web Site: <http://www.bfu-web.de/>

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Investigation Report

5X005-0/02
Mai 2003

Factual Information

Type of Occurrence: Serious Incident
Date: 05. March 2002
Location: Dresden Airport
Aircraft: transport category aeroplane
Manufacturer / Model: Aerospitale /ATR 72-212I
Injuries to Persons: no injuries
Damage: airplane slightly damaged
Other Damage: airport installations
Source of Information: investigation by the BFU

History of the flight

The crew conducted a scheduled flight from Dresden to Stuttgart. 4 crew members and 27 passengers were aboard the aeroplane.

At 20:33 hrs¹ the crew received the take-off clearance from the responsible air traffic control unit (Tower) for runway 22; indicated wind was 190° and 1 kt. The weather was good and there were no obstructions of visibility in the dark night. The runway was dry.

With reaching the decision speed (V_1) during the take-off run the crew felt two or three heavy bumps against the nose landing gear. After a normal gear retraction procedure, the crew checked the aeroplane hydraulic system. There were no irregularities to be found. The crew continued the flight to the destination airport.

The pilot-in-command (PIC) reported to the Tower that during the take-off run the aeroplane had obviously collided with an object (foreign body) on the runway.

During a runway inspection conducted as a result, three lights of the left runway edge lighting were found destroyed.

The landing at Stuttgart was made at 21:37 hrs without any problems.

Investigation

Aerodrome

Dresden Airport has a concrete runway of 2,508 m length and 80 m width. Its true bearing is 041° / 221°. The runway area usable for take-offs and landings is reduced over the whole runway length to a width of 51 m by means of ground markings and lightings.

The aerodrome chart in the Aeronautical Information Publication Germany (AIP) Part 3 (aerodromes), AD 2 EDDC 2-5 dated 24.01.02 shows the runway width of 51 m usable for take-offs and landings (dark coloured). The chart also shows the concrete strips to the left and to the right of the runway (shoulders).

The runway lighting between the threshold and the runway end consists of white elevated edge lights and white surface centre line lights. The edge lights have a 360° omni-directional characteristic and are installed at a distance of 14.50 m from the left and the right edge of the concrete runway. The spacing between the individual lights is 60 m. In the areas of the taxiways (A to E) to and from the runway the lights are surface lights, in order to ensure unobstructed taxiing. The spacing between the white surface centre line lights is 15 m. The lighting is visible in the take-off and landing

¹ Unless otherwise specified, all times are indicated in local time

direction and is only faintly visible from the side (at a right angle to the centre line). In addition the runway has a reflecting white centre line and edge line marking.

The taxiways H and D used by the crew to taxi to runway 22 are equipped with green surface centre line lights. The last centre line light on taxiway D is at the taxi holding position marking. In the turns from taxiway H to taxiway D and from taxiway D to runway 22 blue edge lights are installed on either side. As guidance lines the centre line lights ensure taxiing up to the taxiing holding position marking. The spacing between the lights is 30 m and in turns 15 m.

The green and the blue taxiway lights as well as the runway lighting are jointly switched from the tower.

Taxiways H and D are fitted with yellow centre line markings. In the area of the junction with the runway, the taxiway D marking guides on to the runway centre line.

With a letter dated 20.09.02 the Sächsische Staatsministerium für Wirtschaft und Arbeit (Saxon State Ministry for Economy and Labour) (Reference 56-3848.21) as the approval authority have informed the BFU that following the incident, the Flughafen Dresden GmbH have newly spreaded or supplemented the following markings in the flight operations areas:

- On both sides of taxiways A to E taxiway edge markings with double lines
- transverse strips to protect the shoulders over a width of 90 cm in the areas of the junctions between the taxiways A to E and the runway and
- over the threshold marking of runway 22 a solid taxiway centre line.

Inspection of the condition of the manoeuvring areas by the Dresden Airport GmbH.

On the day of the incident the Airport Duty Officer (VKD) conducted from 20:27 hrs a scheduled routine inspection of the manoeuvring areas for serviceability. It was the fifth inspection on this day (04:30 hrs, 07:10 hrs, 12:25 hrs, 16:00 hrs). The inspection was started at ramp no. 3.

According to the written statement given by the VLD, she drove immediately following the take-off of the ATR 72-212 in agreement with the Tower via taxiway E to runway 22 for the purpose of runway inspection. This statement is contradictory to the statement given by the PIC who said during the enquiry that the VLD drove to the runway via taxiway D. This contradiction could not be clarified by the BFU. However, the BFU

does not consider this contradiction to be relevant to the incident.

The VLD drove on runway 22 from taxiway E into the direction of taxiway A. Before the junction with taxiway C fragments (glass splinters) were found in the area of the south-easterly edge lighting. During a more detailed inspection, three lights in series (from 16 to 18) of the edge lighting were found destroyed. The fragments were scattered on the runway up to the centre line.

The VLD had the documentation, the clearing up, the repair of the lights as well as another runway inspection made after the conclusion of the work and prior to resuming flight operations.

Independently of those actions the VLD informed the Tower immediately after having found the damage, thus the Tower could contact the aeroplanes having departed shortly before. The first aeroplane was a Cessna 650 Citation VII, time of departure 20:32 hrs, and the second aeroplane was the ATR 72-212, time of departure 20:33 hrs.

At 20:38 hrs the PIC of the ATR reported that during the take-off run he had felt two to three heavy bumps against the nose landing gear. The PIC of the Cessna 650 stated upon enquiry by ATC Berlin Radar that during the take-off everything had been normal.

For the debris of the lights found at the site of the incident a conservation of evidence in the form of photos and a measurement was not conducted by the Dresden Airport GmbH. At the request by the BFU a rough sketch only showing the location of the elements of the lights was made afterwards. One lamp element was lying on the ground approx. 25 m southeast of the last broken light (no. 18), the second was approx. in the middle between the left runway edge lighting and the runway centre line off the broken light no. 18 and the last lamp element was near the centre line between the first (no. 16) and the second (no. 17) broken light.

The following morning a commissioner of the BFU photographically documented the marks left on the concrete runway by the three lamps when they were knocked off their sockets. These marks, whose form resembled a flame, were located in the immediate vicinity of the sockets and were almost parallel to the white edge line marking into the direction of 220°. They had a length of approx. 80 cm.

Further traces had not been found by the commissioner at the incident site.

Recording of the period, when the left runway edge lighting had failed, and the take-off time of the ATR.

With a letter dated 15.03.02 by the Dresden Airport GmbH, the BFU have received a record of the time of failure of the three destroyed lights of the runway edge lighting.

The condition of the lightings is monitored at intervals by the operations monitoring system of the airport. In the transformer station supplying the runway edge lighting 19 lighting circuits are cyclically interrogated for this purpose. The record revealed that a complete interrogation of all lights would take about 6.5 minutes.

The failure of the three lights (current circuit 1 one light failed, current circuit 2 two lights failed) was registered by the operations monitoring system at 20:33:56 hrs.

As in the preceding cycle no failures had been registered it is to be assumed that at that time (6.5 minutes prior to the failure registration) the lights had been functioning.

A research concerning the take-off time of the ATR 72-212 was made and it was found that according to the tape transcript of the Deutsche Flugsicherung (German Air Navigation Services) the take-off clearance was granted by the Tower at 20:32:30 hrs. The clearance was read back by the crew at 20:32:35 hrs.

At 20:33:22 hrs a first transponder signal was transmitted by the ATR during the take-off run and at 20:33:42 hrs a further signal was transmitted when the aeroplane was already 500 ft above airport elevation. This means that the take-off (lift-off of the aeroplane) was between 20:33:22 hrs and 20:33:42.

During the period when the three runway edge lights must have failed there were two take-offs from runway 22: The Cessna 650 with the destination Braunschweig and the ATR with the destination Stuttgart.

An inspection of the Cessna 650 conducted the next day by a staff member of the BFU at Braunschweig revealed that the fuselage lower surface and the landing gears of this aeroplane did not show any damage.

ATR 72-212 aeroplane

During a technical inspection of the aeroplane conducted by the operator at Stuttgart the following damage was found:

On the fuselage lower surface, especially in the area between the nose and the main landing gear many

small scratches in the paint were found. The nose landing gear fairing had several deep cuts and holes as well as small dents in the paint and the skin. The lower anti-collision light had been destroyed. The left tyre of the nose landing gear was depressurized and had slight cuts in the tread surface and deep cuts in both sidewalls. The right tyre of the left main landing gear was damaged on the inner sidewall. The left propeller showed several slight impact traces. On the right propeller only one small impact trace was to be found. Glass splinters were found in all wheel wells.

Technical deficiencies of the aeroplane could not be found.

On September 9th, 2002, the left tyre of the nose gear, which had become depressurised during the collision, was sent to the manufacturer (Michelin Aircraft Tires) in Clermont Ferrand (France) for the purpose of a technical examination.

The expertise revealed that the shock burst of the tyre and the extensive destruction of both sidewalls had been caused by a collision with an object comprising glass components.

Inspection of the airport by the BFU

On April 11th, 2002, two staff members of the BFU conducted an inspection of taxiways H and D as well as runway 22 by day and at night.

The markings on the mentioned areas are in conformity with ICAO-Standards and in correct colours. As already explained, a green surface lighting is provided for taxiing at night. It reaches as far as the taxi holding position marking on taxiway D. This lighting also was in conformity with the Standards and Recommendations of ICAO Annex 14.

When driving on the taxiways it was conspicuous that especially against a dark background the green lights shine intensively. According to a statement by the airport operator their luminous intensity cannot be reduced.

Irritations which could have caused a premature leaving of the centre line of taxiway D at night would probably be due to the arrangement of the blue edge lights beyond the taxi holding position marking. The lateral displacement of the last blue edge light to the southwest – on the left side in the direction of taxiing – will at night inevitably lead to the impression that this point is the beginning of the junction to runway 22. It would be understandable if the PIC had reacted to this change in direction of the blue edge lighting by changing the direction of his aeroplane and might have

considered the wrong row of white lights to be the centre line.

Driving tests with an automobile were conducted on the concrete surface left of the runway edge lighting in the take-off direction 22. During these driving tests relatively heavy bumps were found to be transmitted from the concrete area to the automobile, which became heavier with increasing speed. These bumps were caused by the non-maintenance (or poor maintenance) of the joints between the individual concrete slabs. The joint filler was partly missing. On the runway itself these bumps were only very weak.

Crew

The crew held the required licences and ratings for the ATR 72-212.

The PIC had a total flight experience of 10,800 hours, of which 6400 hrs were on the ATR 42/72, which he has flown since April 6th, 1992.

The co-pilot (FO), who has flown the ATR 42/72 since May 2001, has accumulated 4388 flight hours of which 674 hours were on the ATR.

On March 15th, 2002, the crew was interrogated about the incident by the BFU at Braunschweig.

The crew used Dresden Airport regularly by day as well as at night.

The incident flight was the third cycle on this day. Check-in at Bremen was at 15:25 hrs. On the preceding flights there were no incidents or delays.

The turnaround time at Dresden was 45 minutes. The dispatch went off normally without any problems. There was no slot for the departure to Stuttgart.

Block-off at the parking position 35 was at 20:25 hrs. The PIC taxied the aeroplane via taxiways H and D. All lightings of the taxiways and runway 22 were switched on. For taxiing from the parking position to the runway the crew used the aeroplane taxi light. At the taxi holding position marking on taxiway D the aeroplane was stopped for a short time as the cabin crew had not yet completed the preparation of the cabin for take-off. Following the information 'Ready' the PIC taxied the aeroplane on to the runway. Visibility was more than 10 km with the sky almost clear of clouds.

As the PIC stated, they orientated themselves according to the left and the right runway edge lightings, when taxiing on to the runway. In this phase

the FO was reading the BEFORE TAKE-OFF check list.

According to the procedures applied by the operator taxiing on to the runway is to be conducted at an angle of 90°. Only shortly before reaching the centre line the aeroplane is aligned with the take-off direction by means of the nose wheel steering.

During the enquiry the PIC said that he had aligned the aeroplane exactly on the runway centre line by means of the centre line lighting. This was confirmed by the FO.

For the flight from Dresden to Stuttgart it was planned that the FO was to be the pilot flying (PF). Thus the PIC handed the control of the aeroplane over to the FO at approx. 70 kt as provided in the aeroplane flight manual.

During the take-off run the PIC felt the taxiing over the centre line surface lighting by slight bumps against the nose landing gear.

At V_1 (approx. 105 kt) the crew felt two to three bumps against the nose landing gear with the first one felt especially heavy.

The cabin crew had not felt those bumps.

Apart from that the crew did not find anything abnormal during the take-off.

Digital Flight Data Recorder (DFDR)

The evaluation made by the BFU was based on the raw data recorded by the DFDR which had been secured by the operator concerned. Only the parameters relevant to the take-off were subjected to an evaluation.

The evaluation of the recorded headings during take-off shows that the aeroplane heading changed only slightly. The take-off run was started with 221.8°. Until the lift-off 29 seconds later, a maximum heading of 222.5° and a minimum heading of 220.4° was recorded. For a runway true bearing of 221° the maximum deviation was +1.5° and -0.6°.

During the take-off run the aeroplane rudder was deflected slightly to the left (-1.5°) during the first 12 seconds, then for a period of 7 seconds was in neutral position and during the last 10 seconds prior to lift-off was deflected to the right (maximum 3°). In the ATR 72-212, travel of the rudder pedals induced by the pilot is not recorded as a parameter.

The recorded GPS ground speed at the moment of lift-off was between 106 and 110 kt.

From the beginning of longitudinal acceleration until the lift-off, the runway distance travelled by the aeroplane was approx. 674 m.

This distance corresponds approximately to the distance between the point at which the aeroplane taxied on to the runway and the third destroyed lamp of the runway edge lighting.

Analysis

Due to the insufficient documentation of traces on the flight operations areas following the incident, the traces cannot be for the purpose of analysis.

According to the technical findings made by the operator it is to be assumed that the incident had not been caused by a technical defect of the aeroplane.

At the time of the take-off the meteorological conditions were good. In the dark night, there were no obstructions of visibility.

The lighting and markings at Dresden airport complied with the standards and recommended practices of ICAO Annex 14.

All necessary lightings of runway 22 and taxiways H and D had been switched on.

By night, the taxiing direction is clearly indicated by the green centre line lighting from the dispatch apron via taxiways H and D.

By night, the green centre line lighting of taxiway D provides guidance up to the taxi holding position marking.

In parallel to this, the centre line markings of taxiways H and D lead directly to the centre line of runway 22.

The three lights of the left runway edge lighting had been knocked off into a direction of approximately 220°.

The crew knew the airport from approaches and departures by day as well as at night.

When taxiing to runway 22 the crew never was under stress or pressure.

According to their statement they conducted the take-off run on the centre line of runway 22.

In the assessment of the relevant DFDR parameters relevant to the take-off it may be assumed that during the take-off the crew exactly adhered to the take-off heading.

During the period of the failure of the three runway edge lights, two aeroplanes took off: A Cessna 650 and an ATR 72-212. Both aeroplanes were inspected for damage. Damage was found only on the ATR 72-212.

After clarification of all circumstances it was thus to be assumed that the take-off run of the ATR was performed on the left runway edge lighting.

Therefore the statements of the crew concerning the alignment on the runway cannot be concurred with.

From the damage on the aeroplane no clear conclusion may be drawn as to which part of aeroplane had collided with which light.

The fact that the first 9 lights of the lighting had not been damaged during the take-off run can be explained only by

- the alignment for take-off (the nose gear was either to the right or to the left of the runway edge lighting),
- the exact maintaining of the heading during take-off (as shown by the recordings of the DFDR) and
- a small wind component (190° and 1 kt).

Even with the knowledge that the clear width between the tyre of the outer nose wheel and tyre the main landing gear wheel is only 1.52 m it cannot be excluded that the take-off run of the aeroplane was over a distance of 540 m clear of the lights.

A contributing factor was that due to the lacking contrast between the runway surface and the surface of the adjacent side strip it was difficult for the crew to recognize their error of having incorrectly taxied on to the runway.

The statement of the PIC that during the take-off run he had felt the taxiing over the centre line surface lighting by slight bumps against the nose landing gear could be explained by the assumption that these bumps had been caused by the concrete slab joints to the left of the runway edge lighting, which were no longer (or only poorly) maintained.

Conclusions

The incident happened because the pilot-in-command confused the centre line lighting of runway 22 with the left runway edge lighting. This confusion was not noticed by the co-pilot.

Safety Recommendations

The result of the investigations has prompted the BFU to issue the following safety recommendation:

Recommendation NO.: 12/2002

The particularities of flight operations at Dresden Airport should be described in the AIP Germany, EDDC AD 2.23, under Additional Information AD 2.

In addition, AD 2, EDDC 2-5 should contain a reference to the Additional Information under AD 2, EDDC AD 2.23.

Recommendation 12/2002 was introduced in the AIP Germany with the date of 16.05.02 (AD 2 EDDC 2-5 and 2-5A) and 11.07.02 (AD 2 EDDC 1-12).

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assisted by:	
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