

INCIDENT

Aircraft Type and Registration: Boeing 747-236B, G-BDXH

No & Type of Engines: 4 Rolls -Royce RB211-524D4 turbofan engines

Year of Manufacture: 1979

Date & Time (UTC): 3 February 1994 at 1650 hrs

Location: Manchester Airport

Type of Flight: Public Transport

Persons on Board: Crew - 18 Passengers - 90

Injuries: Crew - None Passengers - None

Nature of Damage: Underside of No 4 engine nacelle scraped

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 43 years

Commander's Flying Experience: 8,906 hours (of which 1,791 hours were on type)
Last 90 days - 185 hours
Last 28 days - 64 hours

Information Source: AAIB Field Investigation

Flight History

The aircraft was flying the first sector of a scheduled public transport flight from London Gatwick Airport to Islamabad via Manchester. Prior to departure the flight crew studied the forecast weather information, particularly the landing conditions at Manchester. The forecast indicated that Manchester would have a strong and gusting easterly surface wind with rain showers and the commander considered that these forecast conditions might well exceed the operating company's crosswind limitations for landing on a wet runway. He therefore decided to load an extra 7 tonnes of fuel so that the aircraft could hold near Manchester if necessary to await an improvement in weather conditions and, if this did not materialise, return to Gatwick. He briefed the first officer to obtain the Manchester Automatic Terminal Information Service (ATIS) as soon as possible after takeoff.

The aircraft departed Gatwick at 1602 hrs with the commander as the handling pilot. The first officer copied the Manchester ATIS and 'Information Bravo' advised that radar vectors for an ILS approach to Runway 06 was in operation. The surface wind was 110°/19 kt, visibility 15 km with nil weather. Moderate turbulence was reported below 1,500 feet and windshear below 500 feet with an airspeed loss of 10 kt. The runway was wet. As these conditions were within the operating company's limitations the commander decided to commence descent for an approach and landing on Runway 06.

The let-down briefing and descent checks were carried out and an approach speed (V_{REF}) of 137 kt was noted. However, in view of the reported low level turbulence and windshear the commander decided to use a nominal V_{REF} of 150 kt. The descent and radar vectoring proceeded normally and the aircraft, which was being hand flown by the commander, intercepted the ILS centreline at 2,000 feet. The landing configuration of gear down and flaps 25° was achieved at 1,500 feet. The approach appeared steady although in moderate turbulence and, at 100 feet, the commander reports that the sink rate appeared to increase. He checked this with an increase in power and as the aircraft touched down the drift was removed by application of left rudder and into wind aileron was applied. At touchdown, which appeared to be smooth to all flight crew members, weather conditions deteriorated and heavy rain started to fall. Although the spoilers deployed normally and reverse thrust was applied symmetrically the commander reports that he experienced some difficulty in keeping the aircraft straight. He therefore depressed the brake pedals thereby cancelling autobrake and brought the aircraft to taxi speed as quickly as possible.

The pilot of an aircraft that was awaiting take off clearance at the Runway 06 holding point had observed the landing and reported seeing sparks from the No 4 engine. In addition a member of the airport operations staff who had also observed the landing reported that a few seconds after the main landing gears had touched down and as the aircraft was abeam Link D, the left wing lifted briefly and a large flow of sparks emanated from the right wing area. This information was relayed to the crew of G-BDXH and the aircraft was taxied to the parking stand where passengers and crew disembarked through the normal channels. Examination showed that the No 4 engine cowl had scraped on the ground during the landing run. None of the flight deck crew members had been aware that ground contact had occurred. The aircraft was withdrawn from service for more detailed examination and repair.

Meteorological information

An aftercast of the weather conditions was provided by the Meteorological Office, Bracknell. This states that the synoptic situation at 1700 hrs UTC on 3 February 1994 showed a deep depression centred over south west Ireland maintaining a strong south-easterly surface airflow over the Manchester area.

Weather: Scattered showers
Visibility: 15 km
Cloud: Scattered Cb 800 feet, scattered 1,500 feet
Wind: Surface: 110° 20 kt gusts to 30 kt
3,000 feet: 160° 50 to 55 kt (not taking into account strong cyclonic curvature these values were approaching 75 to 80 kt)
Remarks: With the wind structure in the lower 2,000 feet there was considerable shear and it was probably very turbulent.

The anemograph readings recorded at Manchester at the time of the accident showed that the surface wind measured by the anemometer was generally from 110° with a peak gust of 27 kt. It is considered significant that there are large hangars and buildings sited immediately to the east of and close to the landing zone of Runway 06. The variations that these buildings might cause to both the strength and direction of strong easterly surface winds has not been measured.

Flight Recorders

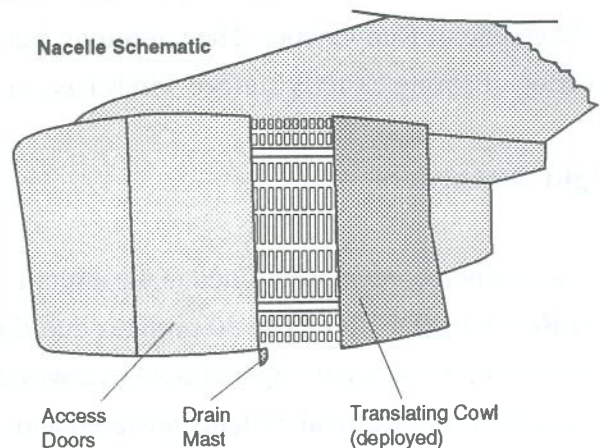
Two accident recorders were fitted to the aircraft, a Cockpit Voice Recorder (CVR) and a Digital Flight Data Recorder (DFDR). The 30 minutes duration CVR was not removed from the aircraft since the airborne part of the recording had been overwritten due to the amount of time the aircraft had spent on the ground with electrical systems powered and the CVR circuit breaker not pulled. The DFDR was replayed successfully at the AAIB. Data stored within the aircraft's Quick Access Recorder (QAR) was also made available by the aircraft's operator.

A plot of relevant recorded data, from 20 seconds before touchdown to 19 seconds afterwards, is at Figure 1. Altitude is referenced to 1013 mb. The landing gear weight switch was sampled once per second and took a value of 'one' when both a left and a right main truck were tilted to the landed position. Peak excursions in aircraft attitude may not have been recorded due to the sampling rates of pitch attitude, four times a second, and roll attitude, two times a second.

The final approach was flown on a heading of 60°M at a descent rate of 700 ft/min and a computed airspeed between 145 kt and 153 kt. The variations in normal acceleration and the degree of control inputs used indicate an approach in turbulent air. Two seconds before touchdown the roll attitude was 4° right wing down, left rudder was being applied and the pitch attitude had increased to 5.2°. The aircraft touched down firmly, banked 2.7° to the right with a pitch attitude at its recorded maximum of 6.1°. Within one second the speed brake lever had started to move and 'aircraft on ground' indications were being recorded. A normal acceleration of 0.75g indicates that the aircraft then bounced or lifted on its oleos before settling again, coincident with a control wheel input of 60% right wing down; two seconds later the aircraft's attitude was recorded as 5.8° right roll and 4.7° of pitch. Over the next 15 seconds large right wing down control wheel and rudder pedal inputs, at times full left rudder, were used to maintain the aircraft on a heading that averaged 55°M.

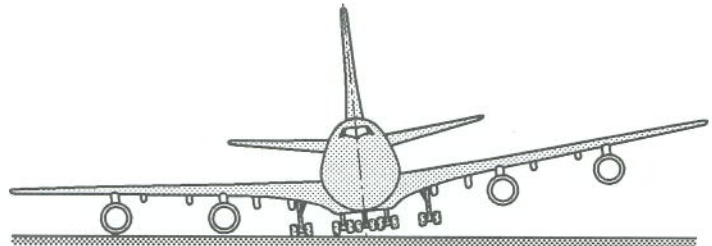
Aircraft Examination

Checks showed that all tyres and landing gear oleos were at correct inflation pressures. Aircraft examination revealed that the underside of the No 4 engine nacelle had been heavily scraped and localised deformation had occurred. The nacelle comprises, from the front, a nose cowl, twin hinged access doors and a thrust reverser translating cowl. The aft edge of the access doors and the forward edge of the translating cowl, when in the forward thrust position, locate onto a fixed nacelle frame. In reverse thrust the translating cowl is driven rearwards approximately 0.8 metre to uncover a fan flow cascade assembly. The fixed frame carries a drain mast at the bottom that protrudes below the nacelle contour. The scraping chiefly affected the translating cowl, with an area approximately 1.1 x 0.8 metre of its under surface heavily abraded and locally distorted. In addition, a small area of the aft lower corner of the each of the access doors had been scraped, the drain mast had been bent backwards through 90° and the central frame had



been scraped and distorted. The damage pattern made it clear that the translating cowl had been well away from its forward thrust position when ground contact occurred, quite possibly in its fully deployed reverse thrust position. Measurements based on the assessed plane of the damage suggested roll and pitch angles of approximately 5.5° and 4.6°, respectively, close to the values recorded 3 seconds after touchdown.

With the aircraft static and unladen the outboard nacelle ground clearance was measured as 1.8 metre. Because the swept wing places the outboard engine nacelles slightly behind the wing main landing gear this clearance would be somewhat reduced by aircraft nose-up pitch with one or both wing landing gears in contact with the runway, as well as by roll angle. Manufacturer's data showed that the DFDR recorded combination of 5.8° roll and 4.7° pitch occurring 3 seconds after initial touchdown was close to the envelope for simultaneous ground contact of a wing landing gear, with its oleo compressed, and the outboard nacelle. This was the only point during the landing and ground roll at which the pitch/roll angle combination approached the envelope. Nacelle ground clearance would also be affected by wing bending and torsional deflection due to dynamic loading, but this could not be adequately quantified in this case.



General Arrangement Schematic with Aircraft Rolled 6 ° Right, 0° Pitch angle

The manufacturer reported 50 known cases of nacelle ground contact during takeoff or landing since the introduction of the Boeing 747, and 42 of them were during the landing phase.

747-236B G-BDXH LANDING INCIDENT ON 3 FEBRUARY 1994

