

Aircraft type and registration: Boeing 737-2K6 HR-SHA (twin jet public transport aircraft)

Year of Manufacture: 1974

Date and time (GMT): 6 November 1984 at 1201 hrs

Location: Lasham Airfield

Type of flight: Air Test/Ferry

Persons on board: Crew — 7 Passengers — None

Injuries: Crew — None Passengers — None

Nature of damage: Severe ingestion damage to No 2 engine, intake cowling detached, outboard 'Clamshell' engine door buckled

Commander's Licence: Airline Transport Pilot's Licence (Honduras)

Commander's Age: 39 years

Commander's total flying experience: 20,000 hours (of which 9000 were on type)

Information Source: AIB Field Investigation

The aircraft had been at Lasham for approximately four weeks undergoing maintenance and it was intended to check the aircraft systems during the flight to Hurn before the subsequent return trip to Honduras. The cloud base at Lasham was 1500 feet and the visibility approximately $\frac{1}{2}$ mile.

The start up was normal and the aircraft taxied to the threshold of runway 09 where it remained for some 12 minutes while the crew completed checks of the engines and other systems. During this period the runway was inspected by airfield staff in a Land Rover. As the vehicle drove along the runway in one direction two flocks of lapwings were frightened away, and as the vehicle returned along the runway to the first intersection no birds were observed on the runway. The runway was reported to be clear and ATC passed the take off clearance to the aircraft.

At approximately 1200 hrs the aircraft accelerated normally along the runway and had just reached VR and begun to rotate when the Commander noticed a large flock of birds in the flight path of the aircraft. He continued the rotation in the hope that the aircraft would fly over the top of the flock. As the birds passed out of sight beneath the nose of the aircraft the crew heard several loud bangs. The Commander noticed that both engines appeared to lose power, and that the EPR and fuel flow gauges of both engines were fluctuating. In order to gain height both throttles were kept at take-off power, the landing gear was raised, and the flaps retracted at the scheduled speeds.

At the time of the bird strike one of the engineers sitting in the passenger cabin on the right hand side saw two birds enter the No 2 engine intake. This was immediately followed by a change in engine note, to a harsh tone, accompanied by a high frequency vibration throughout the airframe. Shortly afterwards he noticed that there was a gap of approximately one inch between the top of the intake cowling and the saddle cowling which extends forward over part of the intake cowling. After a brief discussion with a colleague he went to the flight deck and informed the crew of the situation.

The aircraft had been cleared to 2000 feet but before reaching this height the Commander reduced power on both engines to maintain 210 kt. As he retarded the throttles he noticed that No 1 engine was indicating normally but that No 2 was low on EPR, fuel flow, and other parameters. He therefore increased power on No 1 engine and reduced No 2 to idle. He was reluctant to shut down this engine because he was not completely sure that No 1 was operating satisfactorily. On changing frequency to Farnborough Radar the Commander informed the controller that "we've found some birds on take-off" but at no time during the flight did the crew declare an emergency.

An estimated 7 minutes after the bird strike the engineer heard a dull bump. When he looked at the No 2 engine he saw that the intake cowling was completely missing. He immediately informed the crew. The captain requested and was given vectors to Hurn. He shut down No 2 engine while en route, and then completed an ILS approach to runway 26 and landed at 1217 hrs without further incident. Farnborough Radar was not aware that the cowling had detached from the aircraft. ATC and the emergency services at Hurn knew nothing of the incident, nor did they know that the aircraft had made a single engine landing.

After the landing, the ground engineer reported the cowling loss to his company, who informed the local police.

The complete intake cowling was located roughly 1½ hours later in a field about one mile south of the town of Alton, Hampshire. There had been no injury to persons or damage to property.

The remains of 18 lapwing birds were recovered from the vicinity of the runway at Lasham. Inspection of the aircraft at Hurn showed evidence of some 8 distinct birdstrikes, principally on the nose, windscreen, and port wing. No evidence could be found of bird ingestion by No 1 engine and, after a boroscope inspection and ground run, the engine was declared free of any damage. The No 2 engine, however, had severe damage to all visible compressor stages, including loss of about one-third of a first stage rotor blade. Bird debris was also seen in the compressor stages, although the detached intake cowling had no visible signs of bird impact. The forward edge of the outboard 'clamshell' side cowling door was also buckled, evidently due to the loss of the intake cowling.

The intake cowling is bolted to the front face of the engine via an annular machined attachment ring. Twenty three bolts are used to attach the ring to the engine, and a further twenty five bolts attach the ring to the intake cowling. It was evident that the engine attachment flange of the ring had failed around its circumference and that most of the fracture was of a fatigue nature.

Metallurgical examination of the fracture showed that fatigue had originated in the blend radius of the flange at twenty three origins adjacent to each engine attachment bolt. In the upper part of the ring, the fatigue damage had joined together to produce a total fatigue fracture over this portion. The lower half of the ring exhibited small areas of ductile fracture between the fatigue fractures, substantiating the witness reports that the cowling had become detached from the top. It was estimated that some 97% of the total fracture was of a fatigue nature.

Thus the conclusion reached from the metallurgical examination was that fatigue growth had occurred simultaneously from multiple sites, each associated with a bolt position, and that these cracks accelerated rapidly before settling down to a regular growth under the influence of uniform loading. Since there was no evidence of any long-term pre-existing material defects and the material of the ring was satisfactory, it was further concluded that failure of the ring had occurred due to severe vibration caused by gross out-of-balance forces on the No 2 engine.

The aircraft manufacturer, having also examined the ring has stated that although they have no record of any similar incident of intake cowling detachment, they are in agreement with these conclusions.