

FINAL REPORT

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In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 20 October 2009, appointed Mr. Thomas Moloney as the Investigator-in-Charge to carry out an Investigation into this Incident and prepare a Report. The sole purpose of this Investigation is the prevention of aviation Accidents and Incidents. It is not the purpose of the Investigation to apportion blame or liability.

Aircraft Type and Registration:	Boeing 737-3Q8, G-OBMP
No. and Type of Engines:	2 x CFM56-3C-1
Aircraft Serial Number:	24963
Year of Manufacture:	1992
Date and Time (UTC¹):	19 October 2009 @ 14.20 hrs
Location:	Ireland West Airport, Co Mayo, Ireland (EIKN)
Type of Flight:	Scheduled Public Transport
Persons on Board:	Crew - 5 Passengers - 127
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Significant damage to No. 1 engine, minor damage to No. 2 engine
Commander's Licence:	Airline Transport Pilot Licence
Commander's Details:	Male, aged 31 years
Commander's Flying Experience:	6,000 hours, of which 4,000 were on type
Notification Source:	Duty Airport Manager – Shannon Airport
Information Source:	AAIU Pilot Report Form

SYNOPSIS

On take-off from EIKN the aircraft encountered a flock of lapwings and sustained multiple bird strikes. Both engines were damaged, with bending and distortion of a number of the fan blades of No. 1 engine and the loss of a portion of the acoustic panel from No. 2 engine. The aircraft diverted to Shannon Airport (EINN) where it landed without further incident. No bird patrol had been carried out by Airport staff at EIKN for a period of approximately two and a half hours prior to the aircraft's departure.

¹ UTC: Universal Time Co-ordinated. Add 1 hour for local time. All times in the Report are UTC.

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1. FACTUAL INFORMATION

1.1 History of the Flight

The aircraft departed from Runway (RWY) 09 at EIKN at 14.20 hrs on a scheduled passenger flight to Manchester, U.K. (EGCC). The First Officer was the Pilot Flying. The Commander, who was the Pilot Monitoring, reported to the Investigation that, just as he called “*VI*”², a flock of birds rose from the edge of the runway. The Commander called “*Rotate*” and just at that moment the aircraft hit the birds “*head on*”. The Commander stated that there were a few bangs on the nose of the aircraft and that the flight crew saw numerous birds going down either side of the aircraft. The crew continued to climb straight ahead and noted an increase in vibration indications on No. 1 engine, up to approximately 2.0 units. The Commander stated that, as the aircraft climbed through FL70³ to FL100, the vibration indications increased to between 3.0 to 3.5 units. The flight crew reported no other abnormal indications. The cabin crew reported unusual smells in the cabin and significant vibrations on the left side of the aircraft. Air Traffic Control (ATC) confirmed to the crew that dead birds had been found on the runway. The Commander decided to divert to EINN. The aircraft climbed to FL160 en route to EINN. The crew kept both engines operating and made a normal approach and landing at EINN, touching down at 14.47 hrs without further incident.

1.2 Damage to Aircraft

There was bending and distortion damage to a number of fan blades on No. 1 (port) engine, (**Photo No. 1**). The entire fan blade set (38 blades) was replaced at EINN.



Photo No. 1: No. 1 Engine Fan Blade Damage

² **VI**: Critical engine failure recognition speed during take-off.

³ **FL70**: Flight Level 70, an altitude of 7,000 ft at standard atmospheric pressure.

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An area of the No. 2 engine nacelle fan-duct acoustic panel was missing between the 12 o'clock and 3 o'clock positions. This material was retrieved in five pieces on the runway at EIKN. Two fan blades on No. 2 engine had been distorted but were within Maintenance Manual limits. Both engines were inspected using a boroscope⁴ at EINN but no further damage was found downstream of the fans.

1.3 Aircraft Information

The Boeing 737-300 aircraft type is powered by two CFM56-3C-1 engines. The engines are pylon mounted forward of the wings. The CFM56-3C-1 is a two shaft, high bypass ratio turbofan engine of modular construction. The 38-blade fan and three-stage low-pressure compressor (LPC) are driven by a four-stage low-pressure turbine (LPT) powered by the exhaust gases of the core engine. The 60-inch diameter fan produces about 80% of the total engine thrust, which is almost directly related to fan speed (N1). The thrust is regulated by control of the engine core, which has an annular type combustion chamber and a 9-stage axial flow high-pressure compressor (HPC) driven by a single stage high-pressure turbine (HPT).

An Airborne Vibration Monitor (AVM) system continuously displays engine vibration levels to the crew using indicators on the Engine Instrument System (EIS). The vibrations are displayed on a scale between 0 and 5 units. Aircraft documentation only requires crew intervention if vibration levels exceed 4.0 units, accompanied by airframe vibrations.

1.4 Flight Recorders

The Operator provided the Investigation with read-outs of the data from the Flight Data Recorder (FDR) and the Cockpit Voice Recorder (CVR). The CVR circuit breaker was not pulled after landing in EINN and therefore the recording of the incident flight had been over-written during the subsequent maintenance work at EINN.

Fan vibration parameters were recorded on the FDR for the two engines, each parameter being recorded at 64-second intervals. The first recorded value of No. 1 engine fan vibration after take-off was 0.55 units. As the aircraft climbed to its cruising altitude, the recorded values for No.1 engine fan vibration varied between 0.43 and 0.98 units. In comparison, the highest fan vibration level recorded on the No. 2 engine during this phase of flight was 0.35 units. As the aircraft reached its cruising altitude, the recorded No. 1 engine fan vibrations increased, with a maximum value of 2.85 units. The equivalent levels on No. 2 engine remained considerably lower, with most recorded values being 0.1 units or less.

When the engines were throttled back for the descent into EINN, the recorded values for No. 1 engine fan vibrations dropped to values of 0.1 units and less. Vibration levels increased again as power was increased on the final approach to land, with a highest level of 2.91 units, which was the final recorded value before landing. Other than vibration levels, all other recorded engine parameters were normal throughout the flight.

⁴ **Boroscope:** An item of optical equipment used for visual inspection of otherwise inaccessible areas.

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1.5 Airport Information

EIKN is an international airport located in the west of Ireland at an elevation of 665 ft amsl⁵. It has a single east-west runway, 2,300 meters in length, designated 09-27.

Airport management informed the Investigation that, almost immediately after departure, the flight crew advised ATC that they suspected that the aircraft had suffered multiple bird strikes. The Duty Controller immediately requested a runway inspection, and the bird strikes were confirmed. Eight bird carcasses, later identified as lapwings, were recovered by the airport fire crew. Lapwings are wading birds, with typical weights in the range 150 – 300 grams. The fire crew also recovered five pieces of metal, subsequently identified as parts of the engine acoustic panel. This information was passed on to the duty manager in EINN. The Duty Controller estimated that the total number of birds involved in the incident was in the region of 30 to 40.

The Tower log for the 19 October 2009 indicates that Airport staff carried out bird patrols at 10.04 hrs, 10.45 hrs, 11.24 hrs and 11.51 hrs. No bird activity was reported by any of the patrols. However, no further patrols were carried out prior to the incident flight or a previous flight, an Airbus A320, which had departed six minutes before the incident flight. Thus, no bird patrols were carried out for approximately two and a half hours prior to the incident flight.

The EIKN Manual of Air Traffic Services (MATS) stated, *“Where possible, ATC should request bird patrols prior to the arrival or departure of scheduled or jet traffic. Observed bird activity on or near the aerodrome shall be brought to the attention of the Fire Service Duty Officer.”*

Airport management informed the Investigation that the Duty Controller had stated that, as no bird activity had been observed at any time during the day and since no bird activity had been generated by the departing A320 six minutes before the incident flight, a bird patrol was not deemed to be necessary prior to the incident flight. The Duty Controller expressed surprise that the strike had occurred, as there had been no previous observed or reported bird activity on the aerodrome that day.

1.5.1 Aerodrome Manual

The Aerodrome Manual for EIKN includes a section on Wildlife Hazard Management at Part 4, Section G, dated 31 August 2009. The Manual allocates to ATC the responsibility for day-to-day monitoring of bird activity on the airfield, and for reporting the presence of birds to the Fire & Security Duty Officer. The Manual goes on to state *“However, all personnel with visual and/or physical access to the airside have a responsibility to report the presence of birds to the Fire & Security Duty Officer staff and/or ATC.”* The Fire & Security Duty Officer is responsible for carrying out the necessary bird scaring actions. The Manual states *“The Fire & Security Duty Officer is responsible for initiating and directing activities in clearing birds from the airfield, in order to disperse bird flocks resting on runways. Routine day patrols as well as any patrols requested by ATC shall be carried out to ensure*

⁵ amsl: above mean sea level.

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that bird hazard is controlled. The number of patrols shall be increased during periods of increased bird activity.”

The Manual establishes a Bird Hazard Control Committee with representatives from all the relevant functional areas. It is tasked with meeting four times annually and it has the functions of formulating policy and initiating appropriate action in accordance with best current practice, and with the categorisation of incidents of confirmed bird strikes and other bird hazard related events.

Part 4 Section G contains paragraphs identifying bird species that normally frequent EIKN. These include *“flocks of lapwing and plover which frequent the airport from November to March. From a distance the presence of these flocks is apparent only when they are in flight.”*

1.5.2 Actions Taken Since the Incident

The MATS Manual was amended to state: *“In order to minimise the impact of bird activity on aircraft operations, the Duty ATCO shall initiate a bird patrol prior to the arrival or departure of scheduled or jet traffic”.*

In addition, the EIKN Operations Manager issued Safety Bulletin No. 4/2009 on 1 November 2009, giving a brief description of the Incident and drawing the attention of all staff to their responsibilities under Part 4 Section G of the Aerodrome Manual.

2. ANALYSIS

2.1 The Incident Flight

The recorded FDR data indicates that the bird strikes occurred just as the aircraft took off from RWY 09 at EIKN.

The fact that the recorded fan vibration values for No. 1 engine were relatively high is consistent with what was later found by the maintenance personnel, in that the fan, part of the engine low pressure system, was found with bent and distorted blades. This also suggests that most of the debris bypassed the engine core, after passing through the fan blades.

The Commander’s report indicated that the crew had seen vibration levels on No. 1 engine up to 3.0 and 3.5 units, higher than the highest recorded value in the FDR data, 2.91 units. This may be explained by the fact that, on this particular aircraft, engine vibration data was sampled and recorded at 64-second intervals and thus there were long periods for which no vibration data was recorded. More modern recorder systems have the capacity to record data at higher rates.

The No. 2 engine also sustained significant bird strikes resulting in the loss of a section of acoustic panel, and the deformation of two fan blades, although the deformation was within Maintenance Manual limits. It is probable that the pieces of the panel were ejected through the fan duct. The engine continued to operate normally, with no anomalies in engine parameters.

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Since the aircraft documentation does not require crew intervention at vibration values below 4.0 units, the crew acted correctly in continuing to operate the No. 1 engine normally. Their decision to divert to EINN was prudent in the circumstances, given that they had seen numerous birds go down both sides of the aircraft, that they were seeing abnormally high vibration levels on No.1 engine and that the cabin crew reported significant vibration on the left side of the aircraft, as well as unusual smells in the cabin.

2.2 Airport Aspects

Four bird patrols had been carried out during the morning, with no subsequent reports of bird activity on the aerodrome. As a result, the Duty Controller did not request patrols prior to two departures in the afternoon, the second of which was the incident flight. The MATS Manual gave the Controller discretion with respect to requesting patrols by its inclusion of the phrase, “*Where possible*”.

However, as is demonstrated by this Incident, it is essential for airport authorities to remain vigilant at all times and to develop and maintain constant awareness and a proactive approach to dealing with the serious hazards to aircraft posed by birds and other wildlife.

There is a relatively low level of commercial and jet aircraft activity at EIKN and thus the requirement to carry out mobile patrols prior to aircraft movements is more appropriate there than it would be at airports with more intense traffic levels, where birds are likely to be disturbed by arriving and departing aircraft and thus be more visible to ATC and other airport personnel.

As stated in the Aerodrome Manual, when viewed from a distance the presence of flocks of lapwings is only apparent when they are in flight. Therefore, the requirement for patrols into areas where such flocks may become a hazard is more appropriate than observation from a distance, such as from a Control Tower. This is particularly the case during periods of low traffic density.

After the Incident, the MATS Manual for EIKN was amended to remove the discretion from Duty Controllers with respect to initiating bird patrols prior to scheduled or jet aircraft movements. This is an action which the Investigation endorses. Accordingly the Investigation considers that there is no requirement for a further Safety Recommendation in this respect.

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3. CONCLUSIONS

(a) Findings

1. The aircraft encountered a flock of lapwings and suffered multiple bird-strikes on take-off from RWY 09 in EIKN.
2. No.1 engine sustained bending and distortion damage to a number of fan blades.
3. No. 2 engine sustained a partial acoustic panel loss and minor distortion to two fan blades.
4. No. 1 engine displayed significantly raised fan vibration levels after the bird strikes.
5. The aircraft diverted to EINN, where it landed without further incident.
6. No bird patrol had taken place in the two and a half hours prior to the departure of G-OBMP.
7. The Duty ATC Controller had not requested a bird patrol prior to the departure, as he considered that there was no bird activity on the aerodrome.
8. The Manual of Air Traffic Services allowed the Duty Controller a degree of discretion with respect to the requesting of bird patrols prior to movements.
9. The Manual of Air Traffic Services has been amended to the effect that the Duty Controller shall initiate a bird patrol prior to the arrival or departure of scheduled or jet traffic.

(b) Probable Cause

Damage to both engines as a result of multiple bird strikes.

(c) Contributory Causes

1. The absence of a bird patrol immediately before the take-off of the aircraft.
2. The discretion in requesting bird patrols afforded to ATC personnel by the Manual of Air Traffic Services.

4. SAFETY RECOMMENDATIONS

Because of the actions already undertaken by EIKN management, this Investigation does not make any further Safety Recommendations.

- END -