Boeing 767-336, G-BNWM

AAIB Bulletin No: 10/2000 Ref: EW/ G99/10/18 Category: 1.1

Aircraft Type and Registration:	Boeing 767-336, G-BNWM
No & Type of Engines:	2 Rolls Royce RB211-524H turbofan engines
Year of Manufacture:	1991
Date & Time (UTC):	18 October 1999 at 0848 hrs
Location:	Gatwick Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 11 - Passengers - 129
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Damage to fan section of No 2 engine
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	14,387 hours (of which 1,727 were on type) Last 90 days - 163 hours Last 28 days - 30 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Birdstrike after take off

The aircraft had just taken off and climbed to about 450 feet agl when there was a 'bang' and the No 2 engine ran down. This was accompanied by severe vibration and a number of passengers saw flames coming from the right engine at that time. The pilots, who had both seen a flock of birds disappear under the aircraft just before the incident, believed they had suffered a birdstrike and shutdown the No 2 engine. The commander elected to return immediately and subsequently made an uneventful overweight landing back at Gatwick.

Initial examination of the No 2 engine

Subsequent Inspection of the No 2 engine found that one of the fan blades had fractured and had released the outer third (9 inches) of the blade which had become embedded in the fan duct acoustic lining, just ahead of the outlet guide vanes. Bird remains were evident in the engine and

the fan blades adjacent to the one which had fractured exhibited typical soft body impact damage, with minor curling of their tips. The fan tip-path abradable lining had been heavily gouged and a segment, extending over some 20° of arc, was missing. There were several holes and tears in the acoustic lining. There was no evidence that any damaging debris had not been contained by the nacelle.

The bird remains were sent to the Birdstrike Avoidance Team of the Central Science Laboratory for identification of the species. This showed that the bird had been a wood pigeon, a species which can attain a maximum weight of up to 740 grams (1.65 lbs).

Birdstrike blade damage and certification

The fractured blade and the adjacent damaged blades were taken to engine manufacturer's laboratory for further investigation. Metallurgical examination of the fractured blade parts revealed no evidence of a pre-existing crack, nor of any other material defect which might have rendered the blade particularly vulnerable to the bird impact.

In order to meet the relevant Airworthiness Certification Requirements before entry into service, this engine type had to demonstrate its ability to withstand ingestion of a volley of eight medium sized birds (1.5 lbs each) at take off power with an acceptably small reduction in thrust, the minimum acceptable residual thrust being 75%. During the associated Certification test on this engine type, the engine absorbed the required volley of birds satisfactorily and therefore passed this test. Indeed, the test engine was apparently then used for further Certification tests without significant rectification work having being required.

Although the pigeon which was struck may have been marginally above the 1.5 lbs weight for the 'medium bird' specified in Requirements, it would not have been expected to have had the capability of causing a fan blade to fracture. In service experience of ingestion of similar sized and considerably larger birds has shown that this engine type has continued to operate normally for the remainder of the flights affected. Previous ingestions of considerably larger single birds have been sustained by engines of this type and they have subsequently continued to operate almost normally. The RB 211 engine type has therefore generally been regarded as being more robust than required with respect to bird ingestion.

Effects of detached abradable liner section

Although birdstrikes involving medium size birds would normally cause some gouging of the fan tip path abradable liner, an unusual feature of the engine damage sustained in this incident was the complete loss of a segment of the abradable liner. The segment which had become detached from the fan case had been repaired previously by an approved organisation, using an approved technique.

The tip damage observed on the group of blades, which included the one which had fractured, indicated that the segment of abradable liner had become detached as one section and had then been driven, by the fan blade tips, over the top of the adjacent and still attached segment of abradable liner. It appeared that it had thus acted as a 'ramp' against which the fan blades had been driven, inducing the observed curling deformation of the fan blade tips. It is possible that a combination of this mechanism in addition to the fan-case distortions which can occur as a result of a birdstrike and engine surge could have given rise to critical stresses in the fan blade, inducing failure of its aerofoil.

Action by the engine manufacturer

In view of the this possible mechanism and since the loss of the outer third of a fan blade as the result of an impact with a medium sized bird was not consistent with this engine type's certification test and previous service record in the context of birdstrike damage, the engine manufacturer has undertaken an investigation of the strength and failure modes of the abradable liner, particularly after repairs have been made.