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OPERATIONAL CONSIDERATIONS IN THE EVENT OF MULTIPLE BIRD STRIKES TO MULTI-ENGINE AEROPLANES

1 Introduction

1.1 The increase in the number of large flocking birds, in particular Canada Geese, presents a growing threat to aeroplane safety and an increased risk of multiple strikes and a loss or reduction of available power on more than one engine on a multi-engine aeroplane.

2 Statistical Data

2.1 An FAA-sponsored study of pertinent bird ingestion data for a 30-year period up to 1999 concluded that the loss of power on more than two engines on a three or four engine aeroplane was Extremely Improbable ($<10^{-9}$). However, the study calculated that the current rate of multiple engine power loss, ie more than one engine due to large flocking birds is slightly greater than Extremely Remote (10^{-7} - 10^{-8}).

2.2 An analytical forecast carried out by the Large Flocking Bird Working Group calculated that the rate of multiple engine ingestion would increase by one third over the ten years from 2000 to 2010. This may be conservative as the study was based on data from Canada Geese only.

2.3 Statistics, of course, have a degree of error not least because some bird strikes are not reported. One aircraft manufacturer has calculated the following percentages from **known** events:

- 50 to 60% of bird strikes occur between zero and 50 ft;
- 30% of bird strikes occur between 50 ft and 500 ft;
- 10 to 20% of bird strikes occur above 500 ft.

2.3.1 Engine ingestion occurs in 34% of cases whilst engine failure occurs in 6% of reported cases.

2.3.2 Twenty-one engine failures related to bird strikes were reported to the manufacturer in a two year period, including:

- 13 during the take-off roll;
- 4 during climb;
- 2 during landing; and
- 2 unknown.

3 Operational Aspects

3.1 From the above it can be concluded that the majority of bird strikes occur below 500 ft. In the unlikely event of a loss of power greater than 50%, such that the aircraft is unable to remain airborne, a turn-back at low altitude is not recommended. It has been demonstrated that the minimum height required in order to execute a turn-back in the event of a total power loss is in the order of 1500 to 2000 ft, depending on aircraft type, weight and environmental conditions. The most effective way of achieving this is by an 80/260 procedure turn (this procedure involves a turn of 80 degrees in one direction followed by an immediate turn of 260 degrees in the opposite direction onto a reciprocal heading). It should also be borne in mind that such a manoeuvre may be affected by the loss of other aircraft systems including hydraulics, electrics, flying controls and may need the use of the emergency gear lowering procedure. It is therefore not recommended that operators include such procedures in their manuals unless they have been verified by simulator trials.

3.2 The following are recommended actions:

- (a) The best action is to plan to avoid bird strikes. Crews should consider the safest course of action and brief accordingly. Do not take-off if birds are on the runway. Advise ATC of the situation. Airports are responsible for bird control and must provide adequate means of clearance, such as bird scarers where necessary.
- (b) If a bird strike is suspected, try to confirm that it has in fact taken place, this may be indicated by:
 - birds seen flying very close to the aircraft;
 - bang or other airframe noise or vibration;
 - temporary or permanent change in engine indications;
 - changes in engine sounds, this may be accompanied by engine surge and/or vibration;
 - changes in the indications of flight instruments, eg unreliable IAS;
 - smells from the air conditioning units;
 - reports from ATC or other aircraft.

- (c) If a bird strike occurs, or is suspected on take-off then consider abandoning the take-off. A rejected take-off from relatively low speed is unlikely to have serious consequences and the aircraft should be returned to the ramp for inspection.
- (d) In the case of heavier aircraft, if a bird strike occurs at high speed but below V1 on take-off, it is statistically better to continue the take-off followed by an in-flight turn-back. However, in the event of a multiple bird strike where there is doubt about the integrity of the airframe, or more than one engine, rejecting the take-off should be considered. The crew should discuss the possibility of a high-speed reject at the briefing stage.
- (e) On very short finals, when engines are normally at low thrust, do not go around if birds are encountered but fly through them and land.
- (f) The use of reverse thrust on landing after a bird strike can increase engine damage and should be avoided especially when vibration or EGT is high.

3.3 All bird strikes or near misses should be reported using form CA 1282, regardless of the degree of damage. This is to assist with the collection of data and to ensure that the information on the CAA database is as accurate as possible.

4 Future Requirements

4.1 More demanding requirements will address the increasing risk of engine ingestion of large birds to future engines. EASA and the FAA are intending to harmonise the requirements for the demonstration of the ability of an engine to 'run on' after such an event. The purpose of the 'run on' demonstration is to show that the engine is capable of providing sufficient power and operability, after the ingestion, to allow a continued take-off, initial climb and turn-back to a safe landing. The run on time has been set at 20 minutes albeit with some restrictions on throttle movement. This, of course, is not a guarantee that the engine will run after any bird strike and older engines will have less tolerance to strikes by larger birds.

5 Training

5.1 The training given to flight crews should ensure that they are able to minimise the chances of a bird strike and that they can correctly identify and deal with such an occurrence. In particular, crews should be alerted to the fact that a bird strike may cause unusual aircraft or engine noise and that vibration may be such that the crew are unable to read the engine or flight instruments and may cause further system abnormalities. Nonetheless, the engine may still be producing useful thrust and should only be shut down in accordance with established procedures and when there is sufficient power on the remaining engine(s) to complete a landing. Generally, throttle movements should be kept to a minimum but if the bird ingestion has caused the engine to surge this may be recoverable by closing the throttle; the throttle may then be opened slowly if required. The first priority should always be to fly the aeroplane using the available power to ensure continued safe flight.

5.2 A video produced by the Federal Aviation Administration (FAA) and the Air Transport Association (ATA) entitled 'Turbopfan Engine Malfunction Recognition and Response' was developed to assist flight crews' understanding of engine malfunctions. Copies of the video may be obtained from:

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6 Conclusions

6.1 The risk of a bird strike by a large flocking bird is now greater than was envisaged when the current engine tests were developed. Whilst the optimum solution rests with the airport operators through a bird hazard control programme, operators should ensure that crews are fully aware of the threat and that appropriate precautions are taken. The optimum technique is, of course, to avoid bird contact whenever possible but appropriate procedures should be in place to deal with a strike. This may be unexpected, alarming and may also be accompanied by severe vibration and noise. However, the engine may still function and provide some useful power. The video mentioned above may provide some useful additional information.

This Circular is issued for information, guidance and necessary action.