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Operational Control of Airspeed for Minimizing Bird Impact Hazard

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1. In considering the operational control of airspeed for minimizing bird impact this Paper deals with the structural aspects only, although it will be clear that any measures taken in these respects will probably help to reduce engine damage.

2. For a number of years the British Civil Airworthiness Requirements have required that transport aircraft should be able to resist a 4 lb bird impact anywhere on the airframe structure at the highest forward airspeed likely to be achieved up to 8,000 ft altitude during normal operation.

3. The present US civil requirements are rather different in requiring protection of the windscreen against a 4 lb bird and the horizontal tail surfaces against an 8 lb bird but with nothing specified for the rest of the airframe structure. However, the latest US requirements about to be adopted will correct this omission for future aircraft. The 8 lb bird requirement has not in general been applied to current US aircraft.

4. Nevertheless, as a result of CAA investigation for UK certification most current foreign transport aircraft are believed to have a general 4 lb bird impact capability already.

5. The most sensitive regions high-lighted by these investigations have been :-

(a) windscreens

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(b) the canopy region above the windscreen shielding the overhead control panel

(c) wing and tail leading edges, with the possible vulnerability of fuel tanks, systems, and flying controls, especially if any of these are situated ahead of the front spars.

(d) airspeed probes, which although duplicated may both be destroyed by being either too close together or by being simultaneously struck by disintegrating structure such as the radome.

In a few cases, mostly in the design stage, strengthening of structure, re-routing of systems or re-location of airspeed probes has been found necessary.

6. One may conclude, therefore, that most transport aircraft under the normal circumstances associated with the majority of operations are very unlikely to suffer any serious structural damage from bird impact.

7. However, there will be occasions when larger birds than 4 lb weight may be in the vicinity of aerodromes. Although it is believed that such birds are more predictable in their movement and that airport authorities should be able to give some prior warning to pilots as to their whereabouts - particularly under migratory conditions or where popular feeding ground locations can be identified - experience has shown that the possibility of collision cannot be ruled out.

8. Whilst the UK does not believe that there is an airworthiness case for requiring positive protection against the impact of birds greater than 4 lbs weight, it is anxious nevertheless to take any reasonable steps which can minimize such hazards.

9. Apart from the various punitive measures which airport authorities may be able to take in discouraging birds, a subject which this Committee is actively pursuing, there are positive

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benefits from the operational control of airspeed when it is known that larger birds are in the vicinity of an airport, as indicated from the following considerations.

10. Extensive structural testing in the UK has shown that the force of bird impact is directly related to bird weight and (airspeed)^n, where n lies between 2.7 and 3.0 (and not 2.0 as might be thought from theoretical considerations of the dissipation of energy). It is interesting to note that such a relationship was shown many years ago to be also true for ballistic missile penetration of armour. Thus,

$$\frac{V_2}{V_1} = \left(\frac{W_1}{W_2}\right)^{1/n}$$

where,

W_1 is the bird weight for which structural integrity has been previously established at normal airspeed V_1

and

W_2 is the larger bird weight under consideration and V_2 is the associated reduced airspeed required to maintain structural integrity.

This shows clearly that airspeed has a much more powerful influence on impact force than bird weight. Conversely, it will be evident that a modest decrease in airspeed can produce a disproportionate increase in bird impact resistance. In fact, assuming W_1 = 4 lbs, W_2 = 8 lbs and n = 3.0, then $V_2 \cong 0.8\ V_1$.

11. A 20% reduction in airspeed during climb after take-off or initial approach to landing is believed to be within the capability of most aircraft, but perhaps requiring the more prolonged use of wing-flaps to avoid getting too close to stall or encountering controllability problems.

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12. It is suggested that such an approach could be implemented in the flight crew operating manual, which could give advice on the airspeed reduction procedure which should be followed when, in the opinion of the airport authority and/or pilot, there is an undue risk of encountering birds during either climb after take-off or initial approach to landing.

13. Such an approach has yet to be discussed within the CAA, but the BSCE may wish to endorse such action.

Discussion on WP 21

: It might be dangerous to reduce the speed considerably when flying at the lowest levels. If something happens you are in a worse situation.

Richards: I have not heard before that a moderate reduction of speed can have such an effect.

: What do you think about the use of wing-flaps for speed reduction?

Richards: Use of wing flaps of modern aircraft is an exact method for speed determination and it does not involve any danger.

Pierre: Is it worth while to strengthen the structure of an aircraft in order to get a better safety?

Richards: I don't know but I suppose that a conderable strengthening will become very costly.

Turesson here informed the audience about some details of a paper "Susceptibility of Aircraft to Bird Strike Damage" which was presented by V D Moorthi from the IATA office of Bangkok at the ICAO workshop on reducing bird hazards held in Bangkok last March. According to this paper an increase in weight of 1000 lb for all commercial aircraft belonging to airlines of ICAO states would cause an incresed cost of some 600 million US dollars in purchase price. The cost per year of extra fuel for all those aircraft would amount to about 35 million dollars.