

Proposed Special Condition on the Propeller Bird Impact Assessment

Applicable to Propellers intended for Large Aeroplane installations

Introductory note:

The hereby presented Special Condition has been classified as important and as such shall be subject to public consultation, in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

Statement of Issue:

The bird impact demonstration which is required to show compliance with CS-P 360 "Bird Impact" may result in the release of material from the propeller. This material release may result in no Major and no Hazardous Propeller effect as defined by CS-P 15. Therefore this would be an acceptable outcome according to CS-P. Nevertheless, there is a concern that this result will not ensure the expected aircraft safety level if damages caused by the propeller debris would compromise the aircraft continued safe flight and landing.

Discussion:

CS-P 360 "Bird Impact" requires an assessment of the bird impact threat only in one test condition. The paragraph safety objective is that the propeller is capable of withstanding the impact of the birds which are specified in the certification specifications applicable to the intended installation. There is no consideration for multi-engine installations in CS-P.

AMC P 360 contains the following: "Spinner. An impact site should be chosen that produces maximum loads. The site selected should show that the entire spinner would not separate." The CS-P guidance does not further address the case when only a portion of the spinner or of another part of the propeller is released during the test.

CS-P 15 contains the following definition:

"Hazardous Propeller Effect means an effect that results in any of the following:

- (i) The development of excessive drag.
- (ii) A significant thrust in the opposite direction to that commanded by the pilot.
- (iii) A release of the Propeller or any major portion of the Propeller.
- (iv) A failure that results in excessive unbalance."

No definition is provided in CS-P for a "major portion of the Propeller".

CS-E 540 "Strike and Ingestion of Foreign Matter" requires that Engines must be designed so that the strike and ingestion of foreign matter that is likely to affect more than one Engine in any one flight will not preclude the continued safe flight and landing

of the aircraft. For the bird strike and ingestion threat this is addressed by CS-E 800(d) “Medium and small birds ingestion tests” and CS-E 800(e) “Impact”.

The safety objective of CS-E 540 “Strike and Ingestion of Foreign Matter” which is assumed for large aeroplanes is also applicable to turboprop engines.

In EASA experience, the liberation of portions of the propeller during the bird impact test of CS-P 360 is a rare outcome and CS-P does not contain an appropriate technical specification to address it. Indeed the release of propeller debris after a bird impact may result in damage to the aircraft and/or to the engines. Damage to the aircraft may compromise safe flight and landing. Damage to multiple engines or blockage of the engine inlets may result in engine loss of power or shutdown and may also compromise safe flight and landing.

In order to establish a level of safety equivalent to the one required by CS-E 540 for turbine engines installed on large aeroplanes (see also CS 25.571 “Damage-tolerance and fatigue evaluation of structure” and CS 25.631 “Bird strike damage”) and in compliance with Part 21A.16B(a)1. and Part 21A.16B(b), the following Special Condition shall be applied in addition to the demonstration required by CS-P 360.

Proposed Special Condition:

For Propellers intended for Large Aeroplane installations, in the case when the impact of the bird specified by CS-P 360 results in the release of a portion of the Propeller, and in addition to the showing of compliance with CS-P 360, the applicant must:

- Report the approximate size and weight of the debris released from the Propeller in the conditions of CS-P 360 with an estimate of the trajectory and velocity, so that the effects upon the engine and the aircraft can be assessed;
- Perform an additional Propeller bird impact assessment considering the conditions of CS-E 800(e) “Impact” by tests or analysis based on tests or experience on similar designs and report the approximate size and weight of the debris released from the Propeller (if any) with an estimate of the trajectory and velocity, so that the effects upon the engine and the aircraft can be assessed.
- The resulting information must be considered for inclusion into the instructions required by CS-P 30.

The Engine inlet throat area shall be considered for determining the size of the birds. The assumption made regarding this inlet throat area must be included in the instructions required by CS-P 30. Consistent with CS-E 800(e), the aiming point for the bird will be the most critical location on the propeller for normal flight operations up to 450m (1500 feet).