EASA European Union Aviation Safety Agency	**Consultation paper** **Special Condition**	Doc. No.: CPTS-000398 Issue : 1 Date : 06 NOV 2024 Proposed ☐ Final ☒

SUBJECT	:	Bird Strike and Ingestion - Bird orientation
REQUIREMENTS incl. Amdt.	:	CS-E 800(c), CS-E 800(d)
ASSOCIATED IM/MoC	:	Yes☐ / No ☒ *[Delete last page of associated IM/MoC if not applicable]*
ADVISORY MATERIAL	:	

Table of Content for Public Consultation

INTRODUCTORY NOTE:

The following Special Condition (SC) 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.) 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.*"

ABBREVIATIONS & DEFINITIONS:

CS	Certification Specification
IFSD	In-Flight Shut Down
SC	Special Condition
Applicant	Where in this document it is referred to “the Applicant”, it means the Engine Type Certificate Holder

IDENTIFICATION OF ISSUE:

CS-E 800(a) states the objective that the Engine will respond in a safe manner following specified encounters with birds, as part of compliance with CS-E 540.

CS-E 800(c), for “large flocking bird”, states the bird speed and bird mass, and the acceptance criteria of CS-E800(c)(2) applies, i.e., the ingestion at 90% sea level static Rated Take-off Thrust must not cause more than a sustained 50% thrust lost, as well as not to cause the engine to be shut down during the test, or cause a Hazardous Engine Effect.

CS-E 800(d)(1), for “medium and small birds”, states that for a medium bird mass, as per Table A, the critical ingestion parameters that affect power loss and damage must be determined by analysis or component test or both, and they must include but are not limited to the effects of the bird speed, the critical target location and the first stage rotor speed.

As well, it states that when two or more birds are specified for the test, the largest must be aimed at the Engine core primary flow path and a second bird must be aimed at the most critical exposed location on the first stage rotor blades.

CS-E 800(d)(3), for “Medium and small birds”, requests for a medium bird mass, as per Table A, additional integrity assessment, done by appropriate tests or analysis or both, for the case of birds fired at the most critical locations of the first stage rotor.

In both cases for “Medium and small birds”, the acceptance criteria of CS-E 800(d)(2) applies, i.e., the ingestion must not cause more than a sustained 25% thrust lost, as well as not to cause the engine to be shut down during the test.

The associated acceptable means of compliance, as defined in AMC E 800, provides certain guidance for the definition of critical impact parameters, and examples for the effects of bird mass, bird velocity, fan speed, impact location or fan blade geometry.

Two known field events of medium bird ingestions and one event of large flocking bird ingestion have caused the fracture of the fan blade near the root, followed by an IFSD, and in two events an under-cowl fire. In both cases the birds are assumed by the Applicant to have been presented to the engines in a 90-degree (yaw) orientation to the engine centre line, claimed by the Applicant to be a more adverse orientation for fan blade fracture near the root when compared to an orientation aligned axially with the centre line of the engine, as historically interpreted from CS-E 800.

The Certification Specifications CS-E 800(c), for “Large Flocking Bird”, and CS-E 800(d), for “Medium and small birds”, do not explicitly mention bird orientation. It has been commonly accepted that the rule refers to a benchmark test with axial orientation of the bird to the engine centreline.

It is assumed that the rate of bird strikes with a yaw orientation is significantly lower than the rate of bird strikes with axial orientation, and considering that a yaw bird orientation results in a more severe impact, it might be acceptable that this impact results in higher thrust loss than the ones specified by CS-E 800(c) and (d).

However, the compliance with this benchmark test is intended to provide sufficient robustness to cover the natural random variability of birds encountered in service, therefore increasingly severe conditions related to Engine operating conditions, bird speed, bird mass and orientation would be expected to cause a gradual degradation of the engine behaviour and not an immediate IFSD, including the fracture of the fan blade near the root.

Considering all the above, the following Special Condition is proposed.

M-TS-000398

Special Condition

Bird Strike and Ingestion - Bird orientation

1. APPLICABILITY

This Special Condition is applicable to certification of turbine engines and changes to turbine engines that, due to the engine design and construction characteristics, might show a potential shortfall in integrity capabilities or performance response to the required intent of CS-E 800 following a bird strike with a yaw orientation to the engine centre line instead of the axial orientation (no yaw) commonly considered in the benchmark test used to demonstrate compliance with CS-E 800. This shortfall might not be revealed by CS-E 800(c) and CS-E 800(d) as currently written.

2. SPECIAL CONDITION

When evidence exists that an immediate IFSD or Hazardous Engine Effect could result from:

a) the impact of a bird with a mass not greater than that specified by CS-E 800(c)(1)(iii), but with a bird yaw orientation to the engine centre line instead of an axial orientation as considered for initial demonstration of compliance with CS-E 800(c), OR

b) the impact of a bird with a mass not greater than that specified by CS-E 800(d)(1) and (d)(3), but with a bird yaw orientation to the engine centre line instead of an axial orientation as considered for initial demonstration of compliance with CS-E 800(d),

then, in order to comply with CS-E 800(a), in addition to complying with the specifications in CS-E 800(c) and/or CS-E 800(d), the demonstration of compliance must also require to re-evaluate compliance with CS-E 800(c) and/or CS-E 800(d), as applicable depending on the evidence above, but including the impact of any bird with any bird yaw orientation to the centre line, and with a modified acceptance criteria that the ingestion will not lead to an immediate IFSD or an Hazardous Engine Effect.