

EUROPEAN AVIATION SAFETY AGENCY	<p style="text-align: center;">Project: "Engine Alliance" GP7270, GP7277 engines</p> <p style="text-align: center;">Subject : <i>Equivalent Safety Finding</i> CS-E 790(a)(1) "Ingestion of Large Hailstones"</p>
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Regulation ref.: CS-E 790 "Ingestion of Rain and Hail" dated October 24, 2003

Statement of issue:

"Engine Alliance" demonstrated compliance with 14 CFR 33.78(a)(1) "Ingestion of Large Hailstones" with a combination of analysis and fan blade ice impact bench testing. The requirements of 14 CFR 33.78(a)(1) "Ingestion of Large Hailstones" are identical to the requirements of CS-E 790(a)(1). Both regulations require an engine test.

The FAA accepted this means of compliance with 14 CFR 33.78(a)(1) and declared an Equivalent Levels of Safety, as recorded in FAA TCDS E00072EN: 33.78, Rain and Hail Ingestion, par. (a)(1), ELOS No. 8040- ELOS-05-NE-06

Because "Engine Alliance" did not perform a full engine test, EASA need to review the use an Equivalent Safety Finding with CS-E 790(a)(1). Such an Equivalent Safety Finding has never been published in the Official Publication of the Agency and is considered important enough to require a public consultation, in accordance with EASA Management Board decision No. 07-2004, dated 30 March 2004, Article 3.2.

Discussion:

The requirements of CS-E 790(a)(1) "Ingestion of Large Hailstones" are identical to the requirements of 14 CFR 33.78(a)(1):

(1) The ingestion of large hailstones (0.8 to 0.9 specific gravity) at the maximum true air speed, for altitudes up to 4 500 metres, associated with a representative aircraft operating in rough air, with the Engine at Maximum Continuous power/ thrust, must not cause unacceptable mechanical damage or unacceptable power or thrust loss after the ingestion, or require the Engine to be shut down. One-half the number of hailstones must be aimed randomly over the inlet face area and the other half aimed at the critical inlet face area. The hailstones must be ingested in a rapid sequence to simulate a hailstone encounter and the number and size of the hailstones must be determined as follows:

(i) One 25-millimetres diameter hailstone for Engines with inlet throat areas of not more than 0.0645 m².

(ii) One 25-millimetres diameter and one 50-millimetres diameter hailstone for each 0.0968 m² of inlet throat area, or fraction thereof, for Engines with inlet throat areas of more than 0.0645 m².

EASA position:

Per CS-E 790(a)(1), "*The ingestion of large hailstones ... must not cause unacceptable mechanical damage or unacceptable power or thrust loss after the ingestion, or require the Engine to be shut down.*" Because the effect of ice or water ingestion by the engine is actually better evaluated per CS-E 790(a)(2), it is accepted that CS-E 790(a)(1) intent is to evaluate the mechanical damage caused by the hailstones. This safety objective is comparable with the safety objective of CS-E 800 "Bird Strike and Ingestion".

CS-E 800(f)(1) states:

"Engine tests must be performed as required under CS-E 800 (b), (c) and (d) unless it is agreed that alternative evidence such as Engine test, rig test, analysis or an appropriate combination, may come from the Applicant's experience on engines of comparable size, design, construction, performance and handling characteristics, obtained during development, certification or operation."

It is EASA opinion that such an alternative evidence should also be accepted to show compliance with CS-E 790(a)(1). As recorded in FAA TCDS E00072EN, the FAA had also agreed with the proposed means of compliance.

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Therefore EASA will accept an Equivalent Safety Finding with CS-E 790(a)(1) on the basis of such evidences, in line with the content of CS-E 800(f)(1). The guidance contained in AMC to CS-E 800(4)(c) is also considered appropriate and should be used.

Public Consultation Results:

One comment was received during the public consultation. Please refer to the corresponding "Comment Response Document".

This document was amended before final publication.