



Federal Aviation Administration

Memorandum

Date: December 19, 2014

To: Manager, Engine Certification Office, ANE-140

From: Manager, Engine & Propeller Directorate, ANE-100

Prepared by: Mark Riley, ANE-142

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for International Aero Engines, LLC (IAE, LLC) Project for the PW1133G-JM, Engine Model, FAA Project # TC3289EN-E

ELOS Memo#: TC3289EN-E-P-8

Regulatory Ref: 14 CFR §21.21 and §33.76(c)(7)(i)

This memorandum informs the Engine Certification Office (ECO) of an evaluation made by the Engine & Propeller Directorate on the establishment of an equivalent level of safety finding for the IAE, LLC PW1133G-JM engine model.

Background

On August 3, 2012, IAE, LLC submitted an updated application for Type Certificate to the ECO for the PW1133G-JM engine model.

Title 14, Code of Federal Regulations (14 CFR) §33.76(c)(7)(i) requires that the ingestion of birds into the engine for the medium bird ingestion test must simulate a flock encounter and be ingested within approximately 1 second elapsed time from the moment of the first bird ingestion to the last. Compliance to the regulation is demonstration by engine test under specific operating conditions.

IAE, LLC conducted the medium bird ingestion test on December 8, 2014. During the bird ingestion phase of the test it was confirmed that only 6 of the 7 birds required for the test were ingested into the engine. IAE, LLC elected to terminate the test and therefore did not complete the required engine run-on testing. IAE, LLC proposed to restart the engine, re-stabilize at the same mechanical fan speed as the prior test condition, ingest the remaining bird and complete the full 20 minute run-on sequence. IAE, LLC is proposing an ELOS to

§33.76(c)(7)(i) using compensating factors in accordance with the provisions of 14 CFR 21.21(b)(1).

Applicable regulations

14 CFR §21.21, §33.76

Regulation requiring an ELOS finding

14 CFR §33.76(c)(7)(i)

Description of compensating design features or alternative Methods of Compliance (MoC) which allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

The FAA determined that the following compensating factors used in the modified test proposal as an alternative MoC provide an equivalent level of safety with the requirements of §33.76(c)(7)(i):

IAE used measured test data and analysis to show that the bird impacts act individually and that if the mis-fired bird was ingested during the initial test instead of after one second, it would not have resulted in a stall, loss of thrust control or engine shutdown.

Explanation of how design features or alternative Methods of Compliance (MoC) provide an equivalent level of safety to the level of safety intended by the regulation

The intent of the medium bird ingestion test per §33.76(c), is to demonstrate the capability of an engine to withstand a flocking bird encounter. The size of the birds and the number of birds required for the test is determined by the engine inlet throat area and is defined in the rule. Birds must be aimed at the critical areas of the fan face and the largest bird required must be aimed at the engine core. Ingestion of medium flocking birds may not cause more than a 25% power or thrust loss, cause the engine to be shut down during the required 20 minute run-on demonstration, or result in unacceptable deterioration of engine handling characteristics.

IAE, LLC showed through testing and analysis that ingestion of the single remaining 1 ½ pound bird (that did not fire during the original test) into the same test engine on a subsequent run did not change the test results. After ingestion of the remaining bird, the engine successfully completed the required 20 minute run-on demonstration and met all of the requirements of the rule.

IAE's use of measured test data and analysis to show that the bird impacts act individually and that if the mis-fired bird was ingested during the initial test instead of after one second, it would not have resulted in a stall, loss of thrust control or engine shutdown, provides an equivalent level of safety to the level of safety intended by 14 CFR §33.76(c)(7)(i).

FAA approval and documentation of the ELOS finding:

The FAA has approved the aforementioned ELOS finding in the PW1133G-JM engine model Issue Paper P-8. This memorandum provides standardized documentation of the ELOS finding that is non-proprietary and can be made available to the public. The Engine and Propeller Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS Memorandum number must be listed in the Type Certificate Data Sheet under the Certification Basis section (TCs & ATCs) or in the Limitations and Conditions section of the STC. An example of an appropriate statement is provided below.

Equivalent Level of Safety Finding has been made for the following regulation:

14 CFR §33.76(c)(7)(i) Bird Ingestion (documented in ELOS Memo TC3289EN-E-P-8)

for *A. C. McKenna*
Manager, Engine & Propeller Directorate
Aircraft Certification Service

12/19/2014
Date

ELOS Originated by ACO: Engine Certification Office	ACO Manager: Diane Cook	Routing Symbol: ANE-140
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