



Federal Aviation Administration

Memorandum

Date: JUN 18 2008

To: Manager, Engine & Propeller Standards Staff, ANE-110
Manager, Engine & Propeller Directorate, ANE-100

From: Manager, Engine Certification Office (ECO), ANE-140

Prepared by: Ian Dargin (ECO), ANE-142

Subject: **ACTION:** Pratt & Whitney Canada (PWC) PW545C Validation Program,
Project No. AT2595EN-E – Request for Review and Concurrence with
Equivalent Level of Safety Finding to 14 CFR 33.76(c), Medium Bird
Ingestion.

Memo No.: 8040-ELOS-08-NE-07

Background

In accordance with the provisions of 14 CFR 21, Section 21.21(b)(1), PWC has proposed an alternate method of compliance to the requirements of Section 33.76(c) by demonstrating an Equivalent Level of Safety (ELOS) using similarity analysis and certain engine tests instead of a full engine bird ingestion test as required by the regulation. The similarity analysis and other engine tests are intended to show that the PW545C complies with Section 33.76(c) for medium bird ingestion and run-on capability.

Applicable Regulation

§ 33.76 Bird Ingestion paragraph (c), Amendment 20

Regulation Requiring ELOS

§ 33.76(c) Small & Medium Birds

Description of compensating factors or alternate standards that allows the granting of the ELOS (including design changes, limitations, or equipment needed for equivalency)

PWC has proposed compliance to 33.76(c) by means of similarity analysis of existing test data from other PW500 family engine tests, plus specific PW545C engine tests to demonstrate surge and performance recovery capability, and FOD thrust recovery logic performance which is based on control system reaction to step changes in N1/N2 matching. Basically, the PW545C engine is essentially equivalent mechanically to the PW545B and adds a Full Authority Digital Electronic Control (FADEC). Whereas the PW545B has a hydromechanical control with a supervisory Electronic Engine Control (EEC) and N1 governing, the PW545C has a FADEC with N1 governing. PWC believes their proposed method of compliance approach is the equivalent of actually conducting a medium bird ingestion test on a type design PW545C engine.

Explanation of how compensating factors or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation.

The FAA has concurred with the use of PWC's proposed method of compliance to Section 33.76(c). The FAA has found an adequate degree of mechanical and functional similarity between the proposed PW545C model, and the predecessor model PW545B engine, to use the data in a similarity analysis. The predecessor models successfully completed full engine medium bird ingestion tests, separately verifying specific elements of the PW545C design. For those elements of the PW545C design that could not be substantiated by the predecessor model tests, PWC will conduct specific engine certification tests on a type design PW545C. These tests include inducing high power surges to simulate the required bird ingestion event, and a showing of residual thrust to a corrected level of 81.5% (as demonstrated in the PW545B bird ingestion test and corrected for an increase in the underspeed logic threshold value and worst case ambient conditions), acceptable post bird ingestion operability, post bird ingestion control stability margins, core performance retention and overall hardware durability. The tests will also include an engine demonstration of FADEC system thrust recovery logic by separately simulating a damaged fan and damaged core via false FADEC inputs, and demonstrating that the control system performs its intended function, and that adequate thrust is maintained under these circumstances. FAA agrees that successful completion of these PW545C tests combined with the similarity analysis to previous tests, is equivalent to a single PW545C medium bird ingestion engine test. (Note: The proprietary engineering and regulatory details related to this ELOS have been fully documented in PWC Engineering Report No. 6712, "PW545C Compliance To AWM 33.76(c) Medium Bird Ingestion, Revision 2", dated April 2008 submitted by PWC to TCCA. FAA has reviewed this report as part of the ELOS action.)

FAA approval and documentation of the ELOS

The FAA has approved the proposed ELOS as documented in this Memo. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. However, certain data supporting this action is proprietary. The Engine and Propeller Directorate has assigned ELOS Memorandum No. 8040-ELOS-08-NE-07. This ELOS will be listed in the Certification Basis section of the Type Certificate Data Sheet as follows:

"Equivalent Level of Safety Findings:
33.76, Bird Ingestion, para. (c), Amendment 20, ELOS No. 8040-ELOS-08-NE-07."

Approved by: **"ORIGINAL SIGNED BY:"** *CD*

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