



Federal Aviation Administration

Memorandum

Date: SEP 08 2006

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) PW535B Validation Program, Project No. AT2352EN-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-06-NE-01

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 PW535B 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 PW535B 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 PW535B engine is essentially equivalent mechanically to the PW535A and adds a Full Authority Digital Electronic Control (FADEC). Whereas the PW535A has a hydromechanical control with N2 governing, the PW535B 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 PW535B engine.

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

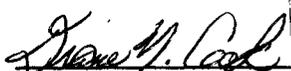
The FAA has concurred with the use of PWC's proposed method of compliance to Section 33.76(c). The FAA has found an adequate degree of mechanical and functional similarity between the proposed PW535B model, and predecessor models PW535A and PW545B engines, to use the data in a similarity analysis. The predecessor models successfully completed full engine medium bird ingestion tests, separately verifying specific elements of the PW535B design. For those elements of the PW535B design that could not be substantiated by the predecessor model tests, PWC will conduct specific engine certification tests on a type design PW535B. These tests include inducing high power surges to simulate the required bird ingestion event, and a showing of recovery of thrust to a level of 80% (as demonstrated in the PW535A bird ingestion test), acceptable post bird ingestion operability, post bird 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 PW535B tests combined with the similarity analysis to previous tests is equivalent to a single PW535B 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. 6542, "PW535B Method of Compliance To AWM 533.76(C) Medium Bird Ingestion, Revision 2", dated July 2006 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-06-NE-01. 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-06-NE-01."

Approved by:

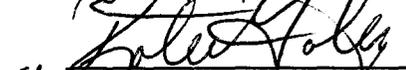


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