



U.S. Department
of Transportation

**Federal Aviation
Administration**

Memorandum

Subject: **ACTION:** Pratt & Whitney (PW) PW6124A and PW6122A Engine Certification Program – Request for Review and Concurrence with Equivalent Level of Safety (ELOS) Finding to 14 CFR Part 33, §33.27(c) Turbine, Compressor, Fan and Turbo Supercharger Rotors-Rotor Integrity Overspeed Test

Date: November 10, 2004

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

Reply
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To: Branch Manager, Engine and Propeller Standards Staff, ANE-111
Manager, Engine and Propeller Directorate, ANE-100

Background

In accordance with the provisions of 14 CFR Part 21, §21.21(b)(1), P&W has requested an alternate method of compliance to the requirements of §33.27 (c) by demonstrating an Equivalent Level of Safety (ELOS) using analysis instead of testing for the PW6124A and PW6122A engine models, further referred to as PW6000A. PW proposed to demonstrate that through engineering analyses the most critically stressed PW6000A rotors meet the requirements of §33.27 (a) and (c). These analyses will show that all PW6000A rotating disks and drums have been designed to have adequate rotor burst speed margin and acceptable growth at all anticipated overspeed conditions as specified in 14 CFR §33.27(c).

Affected Regulation

§33.27, “Turbine, compressor, fan, and turbosupercharger rotors”:

(c) The most critically stressed rotor component (except blades) of each turbine, compressor, and fan, including integral drum rotors and centrifugal compressors in an engine or turbosupercharger, as determined by analysis or other acceptable means, must be tested for a period of 5 minutes.

PW is complying with the overspeed requirements of §33.27 by means of the Material Utilization Factor (MUF) methodology, Reference 1, and augmenting the MUF with their emerging advanced overspeed prediction methodology, (EP). The EP is being used to add confidence in the MUF calculated burst margins and predict rotor growth for each minimum property critical rotor installed in PW6000A engine models.

Compensating Factors

The FAA concluded that an ELOS finding to 33.27 (c) can be reached using the MUF and EP methodologies providing the documentation shows successful demonstration of the accepted compensating factors of:

- Geometric similarity,
- Mechanical similarity, and

- Rotor criticality; with successful demonstration that the PW6000A rotors are within P&W's tested experience, and
- The EP method is correlated.

The FAA concurred with the use of P&W's EP methodology to support P&W's MUF methodology to develop growth data and validate similar failure characteristics between tested rotors and the PW6000 critical rotors. The level of EP correlation will be provided for each similar tested rotor for the different rotor materials used in the PW6000A engine models.

Recommendation

The Engine Certification Office (ECO) has reviewed the data and the analyses provided in report PWA-7680-02 Rev 2, "PW6000 Series Turbofan Engine (PW6124A/PW6122A) Compressor and Turbine Disk /Drum Overspeed Similarity/Analysis Report", and found successful demonstration of the compensating factors for each PW6000A critical rotor component in support of compliance to §33.27(c). P&W has assessed that growth at the worst condition of §33.27(c) for each minimum property critical rotor installed in PW6000A engine models is acceptable, i.e. does not cause a hazardous engine condition.

We therefore recommend the Engine and Propeller Standards Staff concurrence with this finding for an equivalent level safety to the requirements of the §33.27(c).

Upon concurrence, ELOS number 8040-ELOS-04-NE-04 will be listed on the Type Certificate Data Sheet as part of the certification basis for the PW6124A and PW6122A engine models as follows:

Equivalent Level of Safety Findings:

| | | |
|-----------------|-----------------------------------|-----------------------------|
| 33.27 para. (c) | Rotor Integrity Overspeed Test | ELOS No. 8040-ELOS-04-NE-04 |
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References:

Ref 1: PWA 5640, "Pratt & Whitney Aircraft Burst Margin Design Procedure", dated November 16, 1978, latest revision to report June 15, 1993.

Robert Guyotte, Manager
Engine Certification Office, ANE-140

For Concurrence

Robert Ganley, Branch Manager
Engine and Propeller Directorate Standards Staff, ANE-111

Jay J Pardee, Manager
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