



Federal Aviation Administration

Memorandum

Date: November 23, 2015

To: Manager, Boeing Aviation Safety Oversight Office, ANM-100B

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Jim Voytilla, ANM-100B

Subject: INFORMATION: Equivalent Level of Safety Finding for the Engine and Thrust Reverser System Testing on Boeing Company Models 787-8/-9/-10 and 747-8/-8F (Project Nos. TC6918SE-T, PS06-0496, PS06-0497, PS13-0546, PS14-1031, PS05-0211 and PS05- 0212)

ELOS Memo#: TC6918SE-T-P-17

Regulatory Ref: §25.934

The purpose of this memorandum is to inform the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an equivalent level of safety (ELOS) finding for the Model 787-8 airplane.

This memo was subsequently revised to extend this ELOS to the Boeing Models 747-8, 747-8F, 787-9 and 787-10 airplanes.

Background

Title 14, Code of Federal Regulations (14 CFR) 25.934 requires that thrust reversers installed on turbo-jet engines meet the requirements of § 33.97 which requires that a production thrust reverser be installed on the engine during engine endurance calibration, operation, vibration, and reverser cycling testing. Boeing has proposed that an equivalent level of safety to § 25.934 be obtained by using a slave duct for the engine tests required by 33.97(a) and a production equivalent thrust reverser for the reverse thrust part of the test as required by § 33.97(b).

Applicable regulation(s)

§§ 21.21(b)(1) and 25.934

Regulation(s) requiring an ELOS

§ 25.934

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

In lieu of strict compliance with § 25.934, Boeing has proposed that for certification of the Model 787-8 airplane, engine endurance testing in the forward thrust mode using a slave duct provides an equivalent level of safety as that intended by § 25.934. According to Boeing, this approach has been substantiated by many thousands of hours of in-service experience of similar designs. Boeing states that 150 hours of forward thrust running is not a significant demonstration of the structural integrity of a production thrust reverser since it is designed for a life cycle significantly greater in addition to loads developed during a fan blade out event and in-flight limit maneuvers. Boeing further states that the more critically loaded components for durability of the thrust reverser are exposed only during reverse thrust operation.

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation

Determining what is required for approval of a retrofit thrust reverser on a previously type certificated engine/airplane configuration, or on a type certificated engine on a new airplane, has been an issue on several previous certification programs. A memorandum from the Manager of the Aircraft Certification Division, dated December 11, 1986, was written to explain the FAA's policy on demonstrating compliance with § 25.934. That memorandum states in part:

“It appears some applicants have complied with different standards. The principal question has been whether compliance with § 33.87 (Engine 150 hour endurance test) must be demonstrated by actual tests when the thrust reverser is an “add-on” or retrofit design rather than a part of the basic engine type design and approved at the time the engine was certified.

“Advisory Circular (AC) 20-18A, Qualification Testing of Turbojet Engine Thrust Reversers, outlines acceptable means of compliance with the tests prescribed in FAR Part 33 when run under non-standard ambient air conditions. The AC does not address the requirement for a so called “add-on” or retrofit configuration, and one interpretation is that regardless of whether a type certificated engine is involved or not, the reverser installation testing and certification program must include the 150 hour engine endurance test required by § 33.87.

“The policy that has been used by us, and prior to that under the old regional concept, is to forego the extra 150 hour test (§ 33.87) when the engine/airplane configuration has a type certificated engine. When a thrust reverser is to be “added” or retrofitted as part of the aircraft certification, the thrust reverser installation must demonstrate that the engine operation and vibratory levels are not affected. Sufficient test instrumentation is required to provide substantiation data that the operation and vibratory characteristics of the engine are not changed, and the acceptance of this thrust reverser installation by the engine manufacturer should also be provided. It has not been the normal practice to require a repeat of the Part 33 150 hour endurance test for an “added” or retrofitted thrust reverser. The “extra” endurance test is not considered to provide useful data or enhance the assessment or investigation of the thrust reverser system design and

installation reliability or airworthiness and results in an unnecessary burden on many of the applicants without a commensurate increase in the reliability and airworthiness of the reverser design and installation.

“In regard to the other tests specified in § 33.97(a), we have accepted equivalent tests and other appropriate substantiation for showing compliance with § 33.83, § 33.85, and § 33.89. The service history on those reverser installations certified in this manner has been acceptable, and we do not believe the extra 150 hour endurance test would significantly improve the record.”

The FAA has previously granted Boeing similar Equivalent Level of Safety findings to § 25.934 for the Boeing Model 777-300ER and 777-200LR airplanes.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned ELOS finding in project Issue Papers P-17 or Administrative Collector Issue Paper G-6. This memorandum provides standardized documentation of the ELOS finding that is nonproprietary and can be made available to the public. The TAD 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.

Equivalent Safety Findings have been made for the following regulation(s):

14 CFR 25.934 (documented in TAD ELOS Memo TC6918SE-T-P-17).



Transport Airplane Directorate,
Aircraft Certification Service

12/3/2015

Date

ELOS Originated by ACO:	Sherry Vevea	ANM-140S
----------------------------	--------------	----------