Federal Aviation Administration

Memorandum

Date: November 3, 2015

To: Manager, Transport Standards Staff, International Branch, ANM-116

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Douglas Bryant, ANM-112

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Thrust Reverser Testing on the Airbus Single Aisle New Engine Option Model Airplanes (FAA Project Number AT00949IB-T)

ELOS Memo #: AT00949IB-T-P-19

Reg. Ref.: §§ 25.934 and 33.97

This memorandum informs 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 Airbus Single Aisle (SA) New Engine Option (NEO) Model airplanes.

Background

Title 14, Code of Federal Regulations (14 CFR) 25.934 requires that thrust reversers installed on turbojet 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. Airbus has proposed to use a slave C-duct for the forward thrust testing and evaluate the impact of the engine functioning on the stowed thrust reverser based on use of other engine service readiness endurance testing.

Applicable regulation(s)

§§ 25.934 and 33.97

Regulation(s) requiring an ELOS finding

§ 25.934

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

Alternative standards for thrust reverser testing:

PW1100G-JM Installation:

1) Testing with the thrust reverser in the forward thrust configuration:
   a.) Slave C-ducts.
   The engine endurance certification test required by § 33.87 will use slave C-ducts to simulate the production thrust reverser in the stowed position. These slave C-ducts allow for flexibility to adapt the nozzle size to reach the engine redlines during the test. A slave C-duct will also be used on the § 33.85 calibration test, § 33.89 operation test, and § 33.83 vibration test. The slave C-ducts are required to simulate the aerodynamic, thermodynamic, mechanical stiffness and any other characteristics necessary to be effectively identical to the production thrust reverser.
   b.) Production representative thrust reverser.
   Engine bench tests and airplane flight tests will use a production representative thrust reverser. There will be sufficient test time demonstrating simulated flight cycles that will be equivalent to the operating time at idle, maximum thrust, and the number of accelerations to and decelerations from extreme levels of thrust experienced during the § 33.87 engine endurance certification test. Additionally, out of balance testing with 139 cycles (104.5 flight hours) will be conducted with a production representative reverser.
2) Testing with the thrust reverser in the reverse thrust configuration:
   a.) The same production representative thrust reverser unit used to perform the forward thrust configuration testing will be used to perform the 200 reverse cycle testing required by § 33.97(b).

LEAP-1A Installation:

1) Testing with the thrust reverser in the forward thrust configuration:
   a.) Slave C-ducts.
   The engine endurance certification test required by § 33.87 will use slave C-ducts to simulate the production thrust reverser in the stowed position. These slave C-ducts allow for flexibility to adapt the nozzle size to reach the engine redlines during the test. A slave C-duct will also be used on the § 33.85 calibration test and § 33.89 operation test. The slave C-ducts are required to simulate the aerodynamic, thermodynamic, mechanical stiffness and any other characteristics necessary to be effectively identical to the production thrust reverser.
   b.) Production representative thrust reverser.
   The engine vibration test required by § 33.83 will use a production representative thrust reverser. Engine bench tests and airplane flight tests will use a production representative thrust reverser. There will be sufficient test time demonstrating simulated flight cycles that will be equivalent to the operating time at idle, maximum thrust, and the number of accelerations to and decelerations from extreme levels of thrust experienced during the § 33.87 engine endurance certification test.
2) Testing with the thrust reverser in the reverse thrust configuration:

a.) The same production representative thrust reverser unit used to perform the forward thrust configuration testing will be used to perform the 200 reverse cycle testing required by § 33.97(b).

Airbus will demonstrate that:

- The type design thrust reverser will not have structural or operational adverse effect on the engine and the engine will not have structural or operational adverse effect on the thrust reverser; and
- There are no adverse structural or operational effects on the engine due to the operation of the thrust reverser or on the thrust reverser due to the engine operation.

Explanation of how design features or alternative standards provide an ELOS to that intended by the regulation

The use of slave C-ducts during testing demonstrate an equivalent production thrust reverser operation exposure to the engine as would be experienced if a production thrust reverser were used during the required engine certification tests. Additionally, the use of a production thrust reverser during the other engine and airplane testing demonstrates an equivalent engine operation exposure to the thrust reverser as would be experienced if a production thrust reverser were used during those engine certification tests. The use of the same production thrust reverser to also perform the reverse cycle testing meets the requirements of § 33.97(b). The combination of these tests effectively meet the intent of § 25.934. Therefore, although noncompliant with the regulation, the alternative standards are considered to provide an ELOS as that established by demonstrating direct compliance to § 25.934.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in the SA NEO model airplanes project Issue Paper P-19, titled "Thrust Reverser Testing." This memorandum provides standardized documentation of the ELOS finding that is non-proprietary 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 finding. This ELOS memorandum number should be listed in the type certificate data sheet under the Certification Basis section in accordance with the statement below:

Equivalent Level of Safety Findings have been made for the following regulation(s):
14 CFR 25.934, Turbojet engine thrust reverser system tests (documented in TAD ELOS Memo AT00949IB-T-P-19)

Original Signed by Christopher Parker — *November 3, 2015*

Transport Airplane Directorate, Aircraft Certification Service — Date

ELOS Originated by:	Project Engineer:	Routing Symbol:
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