



Federal Aviation Administration

Memorandum

Date: September 17, 2015

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

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: John White, ANM-106B

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Material Design Values on Boeing Models 777-200LR/-300ER and 737-600/-700/-700C/-800/-900/900ER, FAA Project Nos. AT3907SE-T, AT3908SE-T, AT0328SE-T, AT2720SE-T, AT2721SE-T and PS05-0002

ELOS Memo#: AT3907SE-T-A-15

Regulatory Ref: § 25.613

Title 14, Code of Federal Regulations (14 CFR) requires that material strength properties used to show compliance to § 25.613 be based on testing to establish design values on a statistical basis. However, limited use of specification minimum values (S-basis values) has been permitted based on successful past experience for some applications. 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 using S-basis values for limited applications on Boeing Models 777-200LR/-300ER and 737-600/-700/-700C/-800/-900/-900ER.

Background

Boeing has requested an ELOS for § 25.613 at Amendment 25-72 for Boeing Model 777-200LR/-300ER and 737-600/-700/-700C/-800/-900/-900ER airplanes (reference FAA Project Nos. AT3907SE-T, AT3908SE-T, AT0328SE-T, AT2720SE-T, AT2721SE-T and PS05-0002).

Section 25.613, Amendment 25-72, requires that material strength properties be based on a sufficient number of tests to establish a statistical basis for the design values. For single load path structure, § 25.613 further requires the design values must be established with a 99% probability and 95% confidence. For multiple load path structure, the design values must be established with a 90% probability and a 95% confidence. Section 25.613 includes the

requirement that all material strength properties must be based on enough tests of material meeting approved specifications to establish design values on a statistical basis. However, there are materials where statistically derived values are difficult to obtain due to the natural variability observed in these materials.

Boeing occasionally has used materials that do not have design values which meet the statistical requirements defined in § 25.613. In these cases, the specification minimum values (known as “S” basis values) have been used in the design of specific components where there is either limited exposure to unsafe conditions if the component fails, or where there is a long history of safe performance of that component in past designs. These materials in general have been used for specific applications for many years with no adverse service history. The design values not meeting the defined statistical requirements of § 25.613, with consideration of the source, service experience, and application, have been approved on other certification projects by the FAA Administrator on a case-by-case basis. Components for which S-basis design values will be used in design need to be produced using production specifications and processes accepted by the FAA in order to provide the same or higher level of assurance that the variability of the component is accounted for as when statistically derived design values are used in design.

An ELOS to § 25.613 allows the Boeing Model 777-200LR/-300ER and 737-600/-700/-700C/-800/-900/-900ER airplanes to be modified to the previously designed and certified standards of other existing Boeing airplanes. Applying the method described in this memorandum provides an ELOS to, or better than, that provided by the requirements of § 25.613. (Note: § 25.613 has been amended subsequent to establishing the certification basis of Boeing Model 777 and 737 airplanes. Per § 25.613(f), Amendment 25-112, an ELOS is no longer required. Administrator approval may be obtained via letter. Guidance for showing compliance to § 25.613(f) is provided in AC 25.613-1.)

Applicable regulation(s)

14 CFR 25.613, Amendment 25-72

Regulation(s) requiring an ELOS finding

14 CFR 25.613, Amendment 25-72

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

Boeing submitted, and the FAA approved, documentation containing substantiation for design values used for Boeing Model 777-200LR/-300ER and 737-600/-700/-700C/-800/-900/-900ER airplanes. Substantiating data provided includes a description of each material’s usage, associated design values, and reference to the compliance data for all new materials and previously used materials being used in new applications for Boeing Models 777-200LR/-300ER and 737-600/-700/-700C/-800/-900/-900ER.

In the area of new materials and existing material strength properties for the Boeing Model 777-200LR/-300ER and 737-600/-700/-700C/-800/-900/-900ER airplanes, the FAA agrees that material strength properties listed within the documentation will provide an ELOS to § 25.613 requirements for those materials and applications listed in the documentation, which do not explicitly comply with § 25.613.

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

The rationale for a finding of ELOS for use of S-basis design values is as follows:

1. The design values used are equal to or less than the S-basis values (or specification minimum values).
2. Usage of materials with S-basis material design values will be limited to types of materials which have been used in the past on other certified commercial airplanes in similar applications. New types of applications of materials using S-basis design values in models of airplanes will be listed in the documentation for each model and will be compared to previous similar structural applications use on other models of Boeing airplanes.
3. Where comparisons are difficult, the document will provide further details such as additional testing requirements, safety margins, etc.
4. Data is available to support the material specification used (Boeing standards (BMS), industry standards (AMS), or government standards (MIL & QQ-A)).
5. Materials are procured to a specification, i.e., BMS, AMS, or MIL & QQ-A, which define the minimum properties and identify the acceptance testing needed to insure compliance to these properties.
6. Materials are procured from Boeing approved suppliers which have demonstrated the ability to produce the materials by meeting all of the specification requirements.
7. Boeing approves supplier quality systems to ensure material specification conformance. Supplier procurement specifications require that all incoming materials are inspected to ensure conformance with specifications. Such inspections include visual, dimensional, and functional inspection as well as hardness, magnetic particle, penetrant or other tests necessary to affirm required material composition and quality. Suppliers are required to test samples of the material before shipping and to provide statements certifying that all material meets specification requirements before shipping.
8. Boeing maintains a system for the oversight of all materials received. All material test reports are checked against the purchase order requirements and specification. In addition, periodic scheduled checks approved by Boeing are made against material test coupons when they have been accepted on the basis of material certifications or test reports. The supplier establishes schedules for frequency of testing based on historical performance data of the material supplier. Acceptance sampling plans used in acceptance of materials and/or processes by the supplier are approved by Boeing.

9. The fabrication of components and materials whose failure would cause extensive damage to the aircraft, or are made from new materials or processes, or whose replacement would result in very high cost, are subject to additional requirements:
 - a. Special treatment and manufacturing control, e.g., first article inspection, part serialization, frozen processes and manufacturing plan approved by Boeing, annual process audits.
 - b. Boeing review of first production run part, cut-up data which includes mechanical testing, grain flow and micro-structural evaluation (subsequent production runs require mechanical testing for quality validation of each heat treat load per the specification requirements).
10. The materials have a successful history in the Boeing fleet, aircraft industry, and component testing in an appropriately similar application.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned equivalent level of safety finding in Project Issue Paper A-15. This memorandum provides standardized documentation of the ELOS finding for the Model 777-200LR/-300ER and 737-600/-700/-700C/-800/-900/-900ER airplanes 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. This ELOS memorandum number should be listed in the type certificate data sheet under the certification basis section. An example of an appropriate statement is provided below.

Equivalent level of safety findings have been made for the following regulation(s):
 § 25.613 Material strength properties and material design values documented in Transport Airplane Directorate ELOS Memo AT3907SE-T-A-15.

Original Signed by

Ian Won

September 17, 2015

Transport Airplane Directorate,
Aircraft Certification Service

Date

ELOS Originated by Boeing Aviation Safety Oversight Office:	Project Engineer John White	Routing Symbol ANM-106B
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