



# Federal Aviation Administration

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## Memorandum

Date: August 25, 2015

To: Manager, International Branch, ANM-116

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Margaret Langsted, ANM-112

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Adoption of APU Harmonized Requirements on Embraer Model EMB-550 and EMB-545 airplanes, FAA Project # TC0717IB-T and AT10256IB-T

ELOS Memo #: TC0717IB-T-P-7

Regulatory Ref: §§ 21.21(b)(1), Part 25 Subparts E, F and G

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**Revision Description:** The FAA revised the memo to add the Embraer Model EMB-545.

This memorandum informs the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an ELOS finding for the Embraer Model EMB-550 and EMB-545 airplanes.

### Background

Embraer has requested to adopt the proposed Title 14, Code of Federal Regulations (14 CFR) part 25 new Appendix K requirements for the Model EMB-550 and EMB-545 auxiliary power unit (APU) installation rather than comply with the current part 25 subpart E, F, and G applicable airworthiness regulations. The proposed Appendix K requirements are defined in the draft FAA Notice of Proposed Rulemaking (NPRM), Rulemaking Team Draft, dated April 2001. At the time the draft NPRM was written, the location for the proposed APU installation requirements was identified as Appendix K. When completed, the new requirements will be located in a different Part 25 Appendix since Appendix K has subsequently been used for different requirements.

Since the introduction of APUs into transport category commercial aircraft, part 25 requirements have been applied to both APUs and main engines. When part 25 was originally promulgated, APUs were not common in transport category airplanes. Since that time, APUs have become widely utilized in these aircraft.

Advances in APU technology include electronic control systems which allow unattended APU operation, minimal monitoring by the flight crew during APU operation in-flight, and automatic shutdown features for parameter limit exceedence events. In addition, software control of functions previously handled by hydromechanical hardware has become common. Aircraft interface with the APU control system has also evolved with the advances in APU technology. This situation has resulted in an increased number of equivalent safety findings per the provisions of § 21.21(b)(1). In order to address these issues, several of the proposed part 25 Appendix K APU requirements differ from the part 25 main engine installation requirements since they have been updated to reflect existing APU and airplane technology.

Embraer will not meet one of the requirements from the proposed part 25 Appendix K K25.1141(b)(2), or in the corresponding applicable part 25 requirement § 25.1141(f)(2). The requirement in both § K25.1141(b)(2), “APU controls,” and § 25.1141(f)(2), “Powerplant controls,” requires that for APU valve controls located in the flight deck, there be a means to indicate to the flight crew when the valve has not responded as intended to the selected position or function. The Embraer Model EMB-550 and EMB-545 airplanes do not present a direct indication when there is a failure in the APU shutoff valve and it does not reach the commanded position.

#### **Applicable regulation(s)**

§ 21.21(b)(1), part 25 Subparts E, F and G

#### **Regulation(s) requiring an ELOS finding**

14 CFR part 25 Subparts E, F and G applicable to APU installations

#### **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)**

The Transport Aircraft and Engine Issues Group (TAEIG) has forwarded to the FAA an Aviation Rulemaking Advisory Committee (ARAC) formal recommendation to propose the draft 14 CFR part 25 Appendix K as an NPRM. This recommendation was submitted to the FAA in January of 2000, and the proposed rule changes were collectively characterized as category 1 (enveloped). By definition, an “enveloped,” or category 1 rule change accepts the more stringent of the impacted regulations in 14 CFR part 25 and European Aviation Safety Agency (EASA) Certification Specification (CS) 25 (known as the Joint Airworthiness Requirements (JAR) at the time of the ARAC recommendation) subpart J, “Auxiliary Power Unit Installations.” Although the APU harmonization effort resulted in consensus between the FAA and industry, there remains one ongoing part 25 subpart E and draft Appendix K/CS subpart J significant standards difference (§ 25.901(c)) which is the subject of its own ARAC harmonization effort. Until resolution is achieved harmonizing the §§ 25.901(c) and 25.1309 relationships, § K25.901(d) will continue to follow the § 25.901(c) “no single failure” requirement and associated accepted means of compliance.

For § 25.1141(f)(2), the Embraer Model EMB-550 airplane is equipped with a Honeywell Model 36-150[EMB] APU. There is no sensor to monitor the actual position of the APU fuel shutoff valve and metering valve, and therefore there is no corresponding indication in the cockpit for this position. The APU shutdown is controlled by the Electronic Control Unit (ECU) and is performed by two redundant valves. In normal operation, the APU On/Off button commands the ECU. With an APU “off” command, the ECU commands the APU fuel shutoff valve. The ECU then checks for a reduction in APU speed as confirmation that the valve has closed. The ECU then commands the fuel metering valve to close. In case of a protective shutdown, the APU fuel shutoff and the metering valve are commanded simultaneously.

The accomplishment of the APU shutdown command can be verified by the APU Speed and exhaust gas temperature (EGT) indications decreasing. Failure of either the fuel shutoff valve or the metering valve is detected by the ECU and will be annunciated to the flight crew through the crew alerting system (CAS) message “APU FAIL.”

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

The proposed Appendix K, as modified by § 25.901(c), inherently represents a more stringent set of APU installation requirements and may improve the level of safety required by direct compliance to the relevant regulations currently applicable to the Model EMB-550 and EMB-545 airplanes.

Although noncompliant with the regulations, the proposed draft FAA NPRM, Rulemaking Team Draft, dated April 2011, which are harmonized with EASA CS-25 subpart J, “Auxiliary Power Unit Installations,” with § K25.901(d) modified to read the same as § 25.901(c) is continued to provide an equivalent level of safety to the existing part 25 subpart E, F, and G requirements.

For § 25.1141(f)(2), the APU control system automatically commands the fuel metering valve to close after checking a reduction in APU speed as confirmation that the valve has closed. In the case of protective shutdown, the APU fuel shutoff valve and metering valve are commanded simultaneously by the APU control system. The redundancy existing in the APU to command fuel shutoff and the “APU FAIL” annunciation to the flight crew in the case of a valve failure provides an equivalent level of safety to the requirement in § 25.1141(f)(2) .

### **FAA approval and documentation of the ELOS finding**

The FAA has approved the aforementioned ELOS finding in project Issue Paper P-7, titled Adoption of APU Harmonized Requirements. 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):  
Part 25 subparts E, F, and G Powerplant, Equipment, Operating Limitations and Information (documented in TAD ELOS Memo TC0717IB-T-P-7)

*Original Signed by,*

*Christopher Parker*

Transport Airplane Directorate,  
Aircraft Certification Service

August 25, 2015

Date

ELOS Originated by: Propulsion & Mechanical Systems Branch	Project Engineer: Margaret Langsted	Routing Symbol: ANM-112
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