



U.S. Department
of Transportation
**Federal Aviation
Administration**

Policy Statement

Subject: Electromagnetic Compatibility
Demonstration for Airplane Wireless
Radio Frequency Networks

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Summary

This policy statement provides additional Federal Aviation Administration (FAA) policy on demonstrating electromagnetic compatibility (EMC) for wireless radio frequency (RF) systems that are installed on transport category airplanes. The installed wireless RF systems addressed by this policy include those that communicate with portable wireless RF transmitters and receivers carried on board by passengers, crewmembers, or in baggage or cargo; and those that communicate with other installed wireless RF devices. The installed wireless RF systems use standards for, but are not limited to, Bluetooth, Wi-Fi, WiMAX, or mobile telephony. This policy statement defines acceptable airplane EMC tests to demonstrate compliance with Title 14, Code of Federal Regulation (14 CFR) part 25 airworthiness regulations for installed wireless RF systems.

This policy does not apply to installed airplane radio systems that intentionally communicate with radios outside the airplane, such as those that communicate with satellites, ground stations, and radios in other aircraft.

Definition of Key Terms

In the text below the terms “must,” “should,” and “recommend” have a specific meaning that is explained in Attachment 1.

For this policy, “communicate” means to transmit or receive using wireless radio frequency signals.

“Portable wireless RF transmitters and receivers” refer to the portable electronic devices (PEDs) with intentional RF transmitters. Examples of the portable wireless RF transmitters and receivers include mobile telephones, Bluetooth devices, Wi-Fi devices,

or WiMAX devices. The portable wireless RF transmitters and receivers may be embedded into laptop computers, tablet computers, electronic books, handheld electronic games, mobile phones, personal medical devices, portable emergency medical devices, and cargo monitoring devices.

“Installed wireless RF transmitters and receivers” refer to intentional RF transmitters that are in equipment that is installed on the airplane. Examples of these devices include RF transmitters and receivers built into wireless smoke detectors, routers, wireless access points, and in-seat passenger entertainment systems.

“Wireless RF system” refers to installed radio transmitters and receivers, associated antennas, data processing required for the system functions, and portable radio transmitters and receivers that communicate with the installed radio transmitters and receivers.

Current Regulatory and Advisory Material

1. The following regulations provide the requirements for electromagnetic compatibility of electrical and electronic equipment and radios installed on transport category airplanes:
 - a. Section 25.1301(a)(4), *Function and installation*;
 - b. Section 25.1309(a), *Equipment, systems, and installations*;
 - c. Section 25.1353(a), *Electrical equipment and installations*; and
 - d. Section 25.1431(c), *Electronic equipment*.
2. The regulations listed below address the use of PEDs, including portable wireless RF devices, on board aircraft. These regulations require the aircraft operator to determine whether PEDs are acceptable for use on their aircraft.
 - a. Section 91.21, *Portable electronic devices*;
 - b. Section 121.306, *Portable electronic devices*;
 - c. Section 125.204, *Portable electronic devices*; and
 - d. Section.135.144, *Portable electronic devices*.
3. Section 25.1729, *Instructions for Continued Airworthiness: EWIS*, requires preparation of instructions for continued airworthiness applicable to electrical wiring interconnection systems (EWIS) in accordance with appendix H to part 25, sections H25.4 and H25.5, that are approved by FAA.

4. Advisory Circular 20-164, *Designing and Demonstrating Aircraft Tolerance to Portable Electronic Devices*, provides guidance for aircraft certification applicants to demonstrate that their aircraft are tolerant to potential electromagnetic effects from PEDs. This advisory circular (AC) refers to RTCA, Inc. Document No. (RTCA/DO)-307, *Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance*, dated October 11, 2007, and RTCA/DO-307, Change 1, dated December 16, 2008. These documents specify standard procedures that demonstrate an aircraft is tolerant to potential electromagnetic effects from PEDs, including portable wireless RF devices.
5. Advisory Circular 20-168, *Certification Guidance for Installation of Non-Essential, Non-Required Aircraft Cabin Systems & Equipment (CS&E)*, provides primary certification guidance on how to meet the airworthiness requirements for installation of non-essential, non-required aircraft cabin systems and equipment (CS&E). It references RTCA/DO-313, *Certification Guidance for Installation of Non-Essential, Non-Required Aircraft Cabin Systems & Equipment (CS&E)*, dated October 2, 2008.
6. Advisory Circular 21-16, *RTCA Document DO-160 versions D, E, F, and G, "Environmental Conditions and Test Procedures for Airborne Equipment,"* identifies RTCA/DO-160, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated July 27, 1997, December 20, 2005, December 6, 2007, and December 8, 2010, respectively, as containing acceptable environmental qualifications to show compliance with certain airworthiness requirements.
7. Advisory Circular 91.21-1B, *Use of Portable Electronic Devices Aboard Aircraft*, provides guidance to aircraft operators for procedures to determine whether specific electronic devices are acceptable for use on their aircraft.

Relevant Past Practice

Use of PEDs, including portable wireless RF transmitters and receivers, on board aircraft is controlled by the aircraft operators, as required by §§ 91.21, 121.306, 125.204, and 135.144. For commercial air carriers, passenger service announcements and flight attendant observations are the primary means of controlling use of PEDs. Operation of portable wireless RF transmitters and receivers is prohibited unless the operator demonstrates that the airplane model is tolerant to the specific type of portable wireless RF transmitter and receiver.

Consumer electronic devices that incorporate portable wireless RF devices have become commonplace. Aircraft operators, including commercial air carriers, have installed wireless RF systems on board aircraft to provide e-mail and internet access for passengers and crewmembers. The Transport Airplane Directorate developed issue papers to define acceptable means of compliance for demonstrating electromagnetic compatibility for the installed wireless networks and the portable wireless RF devices that can access these networks.

In 2003, the FAA requested RTCA, Inc., to study the risks associated with use of PEDs on board aircraft, especially intentionally transmitting PEDs. The RTCA Special Committee 202 developed RTCA/DO-307, which defines methods that can be used to demonstrate that an aircraft is tolerant to intentional and unintentional electromagnetic emissions from PEDs. In 2010, the FAA published AC 20-164, *Designing and Demonstrating Aircraft Tolerance to Portable Electronic Devices*, which provides guidance on the use of RTCA/DO-307 and RTCA/DO-307 Change 1 to demonstrate aircraft tolerance to PED electromagnetic emissions.

The FAA developed the following policy to promote standardized approaches to demonstrate electromagnetic compatibility when wireless RF systems are installed on transport category airplanes. This policy does not change the existing operational regulations and guidance regarding PEDs.

Policy

1. Installed wireless radio frequency (RF) systems that communicate with other installed wireless RF transmitters and receivers.

- a. The applicant for certification of installed wireless RF systems that only communicate with installed wireless RF transmitters and receivers should demonstrate electromagnetic compatibility (EMC) to comply with §§ 25.1301(a)(4), 25.1309(a), 25.1353(a), and 25.1431(c).
- b. The applicant should use RTCA/DO-160 laboratory EMC tests with guidance in AC 21-16 to qualify the installed wireless RF system equipment.
- c. Standard airplane EMC ground tests or flight tests should be used to demonstrate compliance with §§ 25.1301(a)(4), 25.1309(a), 25.1353(a), and 25.1431(c) for the installed wireless RF system. Appropriate pass/fail criteria for these airplane EMC tests should be defined by the applicant in the respective test plan.

2. Installed wireless RF systems that communicate with portable wireless RF transmitters and receivers on airplanes with demonstrated transmitting portable electronic device (PED) tolerance.

- a. To show compliance, the applicant for certification of installed wireless RF systems that communicate with portable wireless RF transmitters and receivers should provide data that documents the airplane has demonstrated transmitting PED tolerance using RTCA/DO-307, section 3, table 3-1 or an equivalent standard. An equivalent standard should define system RF susceptibility requirements consistent with RTCA/DO-307 table 3-1, including the frequency range and RF susceptibility levels. For example, PED tolerance demonstrated using ED-130, *Guidance for the Use of Portable Electronic Devices (PEDs) on Board Aircraft*, should include RF susceptibility tests that start at 100 MHz.

- b. The applicant must provide evidence that PED tolerance data for that airplane model has been approved by the FAA.
- c. The applicant should use RTCA/DO-160 laboratory EMC tests with guidance in AC 21-16 to qualify the installed wireless RF system equipment.
- d. Standard airplane EMC ground tests or flight tests should be used to demonstrate compliance with §§ 25.1353(a) and 25.1431(c) for the installed wireless RF system. The airplane EMC ground or flight tests should be performed with the installed wireless RF system equipment transmitting to and receiving from transmitting PEDs. The number of transmitting PEDs should be selected to cause the system to operate at high capacity. The transmitting PEDs should be operated in all areas of the airplane that passengers or crewmembers can occupy. The areas should include the passenger cabin, aisles, galleys, lavatories, flight deck, and crew rest areas. At least one transmitting PED should be operated in each area. The intent is to show that airplane compatibility is demonstrated when the installed wireless RF system is operating. It is not intended to further demonstrate PED tolerance for the airplane, since this has already been established. Note that testing in the flight deck does not authorize the use of PEDs by the flight crew. The use of PEDs by the flight crew is strictly controlled and approved operationally as part of the issuance of the operational specifications.

3. Installed wireless RF systems that communicate with portable wireless RF transmitters and receivers on airplanes without demonstrated transmitting PED tolerance.

- a. Installed wireless RF systems that communicate with portable wireless RF transmitters and receivers on airplanes that have not demonstrated transmitting PED tolerance require specific EMC demonstrations.
- b. The applicant should use tests and criteria described in paragraph 1c in this policy.
- c. In addition to the airplane EMC ground or flight tests, the applicant should perform airplane RF susceptibility demonstrations. RTCA/DO-294C, *Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDS) on Aircraft*, and ED-130 provide acceptable guidance on performing the RF susceptibility demonstrations. Airplane RF susceptibility demonstrations should expose the airplane electrical and electronic systems to RF fields that represent the fields from the transmitting PEDs that communicate with the installed wireless RF system. These demonstrations must show acceptable performance for all aircraft systems that perform functions that are required by regulation (such as flight data recorders), or that have major, hazardous and/or catastrophic failure conditions. The RF susceptibility tests should be performed using a transmitter and antenna operating at the maximum effective isotropic radiated power (EIRP) authorized by the national spectrum authorities where the airplane is intended for use. The

maximum authorized EIRP may vary among national spectrum authorities, so typically the highest EIRP should be used. For example, the U.S. Federal Communications Commission (FCC) allows the maximum EIRP for spread spectrum devices such as Wi-Fi to operate at 4 watts EIRP, while other authorities authorize lower power.

- d. The EIRP should be increased by a multiple equipment factor for systems where the EIRP seen at the airplane systems increases when multiple portable devices can transmit simultaneously. RTCA/DO-294C provides guidance on determining the multiple equipment factor. The multiple equipment factor should be determined assuming that the number of transmitting portable devices is equal to the number of passenger and crew member seats in the airplane, unless a different number is justified by the applicant.
- e. A transmitter emulator and antenna may be used to generate the RF fields. The emulator should operate using modulations similar to the authorized modulations for the transmitting PEDs intended for communication with the installed wireless RF system. The transmitting PED or emulator antenna should be positioned to expose electrical and electronic equipment in all locations of the airplane that passengers or crewmembers can occupy. The locations should include the passenger cabin, aisles, galleys, lavatories, flight deck, crew rest areas, and cargo/baggage compartments. Note that testing in the flight deck does not authorize the use of PEDs by the flight crew. The use of PEDs by the flight crew is strictly controlled and approved operationally as part of the issuance of the operational specifications.

4. Installed wireless RF systems that communicate with low power portable wireless RF transmitters and receivers.

- a. The applicant for installed wireless RF systems that communicate exclusively with low power portable wireless RF transmitters (e.g., Bluetooth transmitters) are not required to demonstrate transmitting PED tolerance as described in section 2 and RF susceptibility as described in section 3 in this policy. For this policy, low power portable wireless RF transmitters are those that transmit on the order of 10 milliwatts EIRP or less.
- b. The applicant should use tests and criteria described in paragraph 1c in this policy to demonstrate electromagnetic compatibility.

Effect of Policy

The general policy stated in this document does not constitute a new regulation. FAA employees and their designees and delegations must not depart from this policy statement without appropriate justification and concurrence from the FAA management that issued this policy statement. The authority to deviate from this policy statement is delegated to the Transport Standards Staff Manager.

Whenever a proposed method of compliance is outside this established policy, the project aircraft certification office has to coordinate it with the policy issuing office using an issue paper. Similarly, if the project aircraft certification office becomes aware of reasons that an applicant's proposal that meets this policy should not be approved, the office must coordinate its response with the policy issuing office. Applicants should expect that certificating officials would consider this information when making findings of compliance relevant to new certificate actions. In addition, as with all guidance material, this policy statement identifies one means, but not the only means, of compliance.

Implementation

This policy discusses compliance methods that should be applied to type certificate, amended type certificate, supplemental type certificate, and amended supplemental type certification programs. The compliance methods apply to those programs with an application date that is on or after the effective date of the final policy. If the date of application precedes the effective date of the final policy, and the methods of compliance have already been coordinated with and approved by the FAA or its designee, the applicant may choose to either follow the previously acceptable methods of compliance or follow the guidance contained in this policy.

This policy discusses administrative design approval options available to applicants for type certificate, amended type certificate, supplemental type certificate, and amended supplemental type certification programs. These administrative compliance options are currently available and will continue to be available until regulatory changes preclude the need for these administrative design approval options.

Conclusion

This policy establishes a means of compliance for demonstrating electromagnetic compatibility of airplane wireless radio frequency networks.

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Attachment

Attachment 1

Terms

Table A-1 defines the use of key terms in this policy statement. The table describes the intended functional impact.

Table A-1 Definition of Key Terms

| | Regulatory Requirements | Acceptable Methods of Compliance (MOC) | Recommendations |
|--------------------------|--|--|---|
| Language | Must | Should | Recommend |
| Meaning | Refers to a regulatory requirement that is mandatory for design approval | Refers to instructions for a particular MOC | Refers to a recommended practice that is optional |
| Functional Impact | No Design Approval if not met | Alternative MOC has to be approved by issue paper. | None, because it is optional |