U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Use of Portable Electronic Devices Aboard Aircraft

Date: 10/27/17 **AC No:** 91.21-1D

Initiated by: AFS-300 **Change:**

1 **PURPOSE OF THIS ADVISORY CIRCULAR (AC).** This AC provides aircraft owners, operators (i.e., certificate holders), and the flying public with information and guidance to comply with Title 14 of the Code of Federal Regulations (14 CFR) part 91, § 91.21. Section 91.21 was established because of the potential for portable electronic devices (PED) to interfere with aircraft navigation or communication systems, and prohibits the operation of PEDs not installed aboard U.S.-registered civil aircraft while operating under instrument flight rules (IFR). Section 91.21 permits the use of specified PEDs and other devices the operator of the aircraft has determined will not interfere with the safe operation of the aircraft. The recommendations contained herein are one means, but not the only means, of complying with § 91.21 requirements pertaining to the operation of PEDs.

2 **AUDIENCE.** This AC is for aircraft owners, operators, and the flying public.

3 **WHERE YOU CAN FIND THIS AC.** You can find this AC, ACs referenced in this document, on the Federal Aviation Administration (FAA)'s website at http://www.faa.gov/regulations_policies/advisory_circulars. You can find a current list of Information for Operators (InFO) at http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/info/all_infos.

4 **WHAT THIS AC CANCELS.** This AC cancels AC 91.21-1C, Use of Portable Electronic Devices Aboard Aircraft, dated May 7, 2015.

5 **RELATED 14 CFR PARTS.** You can find the current regulations at http://www.ecfr.gov.

- Part 91, § 91.21.
- Part 121, § 121.306.
- Part 125, § 125.204.
- Part 135, § 135.144.

6 **BACKGROUND.**

6.1 **Section 91.21—Portable Electronic Devices.** Section 91.21—formerly § 91.19—was established in May 1961 to prohibit the operation of frequency modulation (FM)

receivers since they were determined to interfere with the operation of aircraft navigation and communication systems. The FAA subsequently determined other PEDs could be potentially hazardous to aircraft systems if operated aboard aircraft. Amendment 91-35 amended the scope of former § 91.19 to prohibit the use of additional PEDs aboard certain U.S.-registered civil aircraft. Section 91.21, as adopted, was drafted to require the air carrier or commercial operator to determine whether a particular PED will cause radio frequency (RF) interference when operated aboard its aircraft. This AC uses the term "operator" throughout to mean pilot in command (PIC), renter-pilot, or air carrier certificate holder.

6.2 AC 20-164, Designing and Demonstrating Aircraft Tolerance to Portable Electronic Devices. In June 2017, the FAA published aircraft certification guidance AC 20-164. This AC refers to RTCA DO-307A, Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance, as an acceptable method for demonstrating aircraft tolerance to intentional transmissions and spurious emissions from PEDs. The AC also provides guidance for aircraft certification applicants to gain FAA approval for data demonstrating aircraft tolerance to PEDs.

6.3 InFOs 13010 and 13010SUP. Based on some PED Aviation Rulemaking Committee (ARC) recommendations, the FAA published InFO 13010, Expanding Use of Passenger Portable Electronic Devices (PED), on October 31, 2013, and InFO 13010SUP, FAA Aid to Operators for the Expanded Use of Passenger PEDs, on June 9, 2014. These companion documents provide a near-term method for an operator to determine if it can safely expand PED use throughout various phases of flight, and what actions it should take when making those determinations. InFO 13010 and InFO 13010SUP provide acceptable methods for aircraft operators to expand PED use in compliance with §§ 91.21, 121.306, 125.204, and 135.144.

6.4 InFO 17008, The Transportation of Portable Electronic Devices (PED) in Checked Baggage. The FAA published InFO 17008 to raise awareness of the risks associated with prohibiting the carriage of PEDs in carry-on baggage. This InFO requests the aircraft operators to apply safety risk assessments through their safety management systems (SMS) process to identify and mitigate the risks associated with carriage of PEDs containing lithium batteries.

6.5 PED ARC. On January 7, 2013, the FAA Administrator established the PED ARC to provide a forum to review PED policy and guidance by the U.S. and European aviation communities and government regulatory groups. The ARC made recommendations to further clarify, and provide guidance on, allowing additional PED usage without compromising safe aircraft operation. The ARC reviewed current available data submitted by the FAA, other Federal agencies, including the Federal Communications Commission (FCC), industry associations, and ARC subject matter experts (SME). The ARC also reviewed current guidance material and information on PEDs, including documents developed by the FAA, RTCA, and the FCC; and spent 9 months completing a report detailing expanded PED use. The ARC submitted its final report and recommendations to the FAA on September 30, 2013. The report contained

recommendations that could be implemented in the very near term, as well as changes in policy and guidance needing additional time to consider and implement.

6.6 RTCA DO-199, Potential Interference to Aircraft Electronic Equipment from Devices Carried Aboard. RTCA Special Committee (SC)-156 studied the potential for interference from PEDs, and, in September 1988, released volumes I and II of RTCA DO-199.

6.7 RTCA DO-233, Portable Electronic Devices Carried Onboard Aircraft. RTCA SC-177 did a further study of these devices and in August 1996 released RTCA DO-233. The findings and conclusions from this and the RTCA DO-199 study helped the FAA establish policy enabling non-transmitting PED usage during the cruise phase of flight.

6.8 RTCA DO-294, Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDS) on Aircraft. In March 2003, the FAA requested that RTCA form an SC to evaluate and develop guidance to assess the impact and risk of intentionally radiating PEDs, or transmitting PEDs, brought onto civil aircraft by passengers. These PEDs include mobile telephones, computers with wireless network capabilities, and other wireless-enabled devices such as Personal Digital Assistants (PDA). On December 16, 2008, RTCA released RTCA DO-294, prepared by RTCA SC-202. RTCA also released RTCA DO-294 versions A, B, and C.

6.9 RTCA DO-307, Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance. In October 2007, RTCA released RTCA DO-307 (and Change 1 in December 2008), prepared by RTCA SC-202. RTCA DO-307 defines qualification recommendations for aircraft system and equipment RF susceptibility, providing tolerance to RF from intentionally transmitting PEDs. Also, RTCA DO-307 defines acceptable interference path loss between aircraft radio receivers and spurious RF emissions from transmitting and non-transmitting PEDs. On December 15, 2016, RTCA published RTCA DO-307A, prepared by SC-234. This revision 1) changed certain PED tolerance requirements for back-door coupling based on existing high intensity radiated fields (HIRF) requirements, 2) updated front-door interference path loss targets based on criticality of aircraft radios, and 3) clarified requirements for aircraft equipment configuration management.

6.10 RTCA DO-363, Guidance for the Development of Portable Electronic Devices (PED) Tolerance for Civil Aircraft. On December 15, 2016, RTCA published RTCA DO-363, prepared by SC-234. This guide takes into account the safety risk assessment derived from 1) PED ARC Final Report, Appendix F: Avionics System Functional Hazard Risk Assessment; 2) FAA InFO 13010; 3) InFO 13010SUP; and 4) industry-learned best practices since the 2013 publication of these documents. RTCA DO-363 provides a guide to aircraft operators, aircraft manufacturers, equipment manufacturers, certification applicants, maintenance personnel, and maintenance service providers in establishing an aircraft as PED tolerant, and sustaining PED tolerance throughout the aircraft's lifecycle. RTCA DO-363 supersedes guidance in RTCA DO-294C.

Note: To obtain the PED report or any of the RTCA documents referenced in this AC, see paragraph 12.

7 TECHNICAL SUBSTANTIATION.

7.1 Permitting the Use of PEDs. The related 14 CFRs in paragraph 5 enable PED operation not interfering with aircraft navigation or communication systems, per operator determination. By regulation, the operator only is responsible for permitting the use of a particular PED technology. Determining the potential for PED interference on the aircraft communication, navigation, surveillance, and other electronic systems resolves the decision to allow PED usage. For operating certificate holders, the decision to allow PED usage must be made by the operator by following the results of an electronic interference evaluation using acceptable methods. Operators can use acceptable methods published in paragraph 7.2 (below) of this AC, or equivalent methods specifically accepted by the FAA. If the operator lacks the personal knowledge of these methods, the operator should consult an appropriately trained and knowledgeable expert.

7.2 Acceptable Methodology. Policies for allowing the use of PEDs originally addressed analysis of individual transmitting and non-transmitting PEDs to determine possible interference. However, the number and variety of PEDs in use today make analysis of individual devices impractical. The following paragraphs describe acceptable methods to evaluate an operator's aircraft fleet to determine appropriate PED use.

7.2.1 Aircraft Designed and Certified PED Tolerant. Aircraft manufacturers with access to aircraft electronic system qualifications and aircraft radio receiver antenna installation data can easily demonstrate an aircraft meets the requirements of RTCA DO-307A. Operators may obtain statements of such demonstrations from an aircraft manufacturer to substantiate PED tolerance of the aircraft. Operators can also use the RTCA DO-307A methods in demonstrating PED tolerance of their aircraft. RTCA DO-307A separates demonstration methods for tolerance to intentional transmissions from PEDs versus tolerance to spurious emissions from PEDs. Aircraft with an FAA-approved system—such as an Onboard Mobile Telecommunications System (OMTS), Wireless Fidelity (WiFi), airborne access systems (AASs), or Network Control Units (NCUs)—are considered PED-tolerant for PEDs used with the installed system. If an aircraft model has demonstrated tolerance for both transmitting and non-transmitting PEDs, the operator may allow PED use during all phases of flight on this aircraft model.

7.2.2 Aircraft Not Designed and Certified PED Tolerant. An operator may choose to conduct a safety risk assessment following the process in RTCA DO-363 if it 1) does not have a designed and certified PED-tolerant aircraft, and 2) chooses not to test its aircraft fleet types according to RTCA DO-307A or obtain supporting documentation from an aircraft manufacturer. The operator's assessment must evaluate the avionics configuration of its fleet and failure modes of communication, navigation, surveillance, and other electronic systems with respect to electromagnetic interference. This assessment ultimately outlines mitigations and controls the operator needs to adopt to expand PED use into various phases of flight.

Note: For non-HIRF or partial HIRF aircraft, the RTCA DO-363 safety assessment process requires backdoor coupling assessments for flight data recorder (FDR) and cockpit voice recorder (CVR) equipment. The existing FDR and CVR Technical Standard Order (TSO) environmental qualification is acceptable verification, so further backdoor assessment of the FDR and CVR equipment is not required by the operator.

7.2.3 Aircraft Not Demonstrated PED Tolerant. If the operator has not demonstrated PED tolerance for their aircraft, they may allow PED operation during cruise flight. If interference to aircraft systems from PEDs is experienced during cruise flight, the devices causing interference should be isolated, and applicable conditions recorded. The device responsible for the interference should be turned off.

8 OPERATIONAL CONSIDERATIONS.

8.1 Operator Procedures. If an operator allows PEDs aboard its aircraft or the aircraft being operated, procedures should be established to control PED use during aircraft operations. RCTA DO-363 section 7.5 and InFO 13010SUP provide further guidance on what to include in the operator's policies, procedures, and training programs. In general, the procedures should address:

1. PEDs approved for use onboard the aircraft;
2. Times of approved PED operation;
3. How and when PEDs must be secured or stowed;
4. PED modes of operation used and not used;
5. How and when to inform passengers of the aircraft operator's PED policies and procedures; and
6. How to manage scenarios such as suspected or confirmed electromagnetic interference, PED unit or battery smoke or fire, or other scenarios.

8.2 Passenger Communication. This paragraph outlines methods to inform passengers of permissible times, conditions, and limitations of PED usage. These methods may be accomplished through the departure briefing; passenger information cards; flightcrew, flight attendant (F/A), or prerecorded announcements; or other methods deemed appropriate by the operator. Operators should inform passengers of PED use restrictions, such as prior to departure, after takeoff (at 10,000 feet), prior to landing (at 10,000 feet), and after landing. For air carrier operations conducted under part 121 or 135, the limitations, at a minimum, should state the use of all such devices—except medical electronic devices such as heart pacemakers or portable oxygen concentrators (POC)—is prohibited during phases of operation when they could interfere with communication or navigation equipment onboard the aircraft or the ability of the flightcrew to give instructions in the event of an emergency. Methods of passenger communication may include:

1. Procedures to terminate operation of PEDs suspected of causing interference with aircraft systems.
2. Procedures for reporting PED interference to a responsible Flight Standards office.
3. Procedures for cockpit-to-cabin coordination and cockpit flightcrew monitoring procedures.
4. Procedures for determining acceptability of PEDs for operation aboard its aircraft. Acceptable PED identification should be clearly spelled out in oral departure briefings and by written material provided to passengers.
5. Procedures for takeoff and landing preparation must be considered when allowing the PED operation during these phases of flight. Operators must recognize that the potential for personal injury to passengers is a crucial consideration, as well as the possibility of missing significant safety announcements during takeoff and landing. InFO 13010 and InFO 13010SUP provide guidance to address these considerations.

8.3 Use of a PED as an Electronic Flight Bag (EFB). An EFB is any device, or combination of devices, actively displaying EFB applications authorized per AC 120-76, Authorization for Use of Electronic Flight Bags. EFB applications may be displayed on a PED. Additional guidance for part 91 operations can be found in AC 91-78, Use of Class 1 or Class 2 Electronic Flight Bag (EFB).

8.3.1 If an aircraft is eligible for passenger PED use in all phases of flight without restriction, the same eligibility may apply to PEDs authorized as EFBs per OpSpec/MSpec/LOA A061, Use of Electronic Flight Bag.

8.3.2 If an aircraft is not eligible for PED use for all phases of operation, then operators should follow guidance in paragraph 7.2.2 or AC 120-76 for other EFB PED test methods.

8.3.3 During part 121 operations, if a crewmember uses a PED displaying an EFB application not authorized per OpSpec/MSpec/LOA A061, then he or she may be violating § 121.542(d). Per this section, flightcrew members must not use wireless communications devices or laptop computers for personal use while at their duty station on the flight deck while the aircraft is in flight, unless that usage is per FAA approved operational procedures. For more information, refer to InFO 14006, Prohibition on Personal Use of Electronic Devices on the Flight Deck.

8.4 Safety Management System (SMS). A vital part of an SMS is to continuously monitor performance of changed functions and measure performance against planned goals. When expanding the use of PEDs, operators should adopt the principles of safety assurance to validate those operations. Operators should implement a monitoring or control program to continuously assess a PED risk.

9 CELLULAR AND ONBOARD TELEPHONE SYSTEMS.

9.1 Restricting Airborne Cellular Telephone Use. There are additional considerations for PEDs with cellular or mobile telephony capabilities. These PEDs include mobile telephones and computers with cellular wireless network capabilities. The FCC prohibits cellular telephone operation while airborne, as noted in Title 47 of the Code of Federal Regulations (47 CFR) part 22, § 22.925. This restriction is valid for all aircraft without technical provisions that enable control of onboard mobile devices to eliminate interference between ground-based cellular stations and airborne cellular devices. If technical provisions are installed, compliant with, or exempt from 47 CFR § 22.925, then usage of cellular-enabled PEDs is acceptable.

9.2 Compliance With FCC Rules. The FAA supports this restriction on airborne cellular telephone use while in U.S. airspace. The FAA allows the use of cellular telephones in aircraft while on the ground. While airborne, operators should instruct passengers to turn off cellular telephones, disable a PED's cellular transmitting functions, or place PEDs in airplane mode that have cellular or mobile telephony capabilities. The operator's procedures should be clearly described in oral briefings prior to departure or in written material provided to passengers.

9.2.1 If an operator allows passengers to use an installed mobile telephone system, then the operator should instruct passengers to turn off cellular telephones, disable PED cellular transmitting functions, or place PEDs in airplane mode that have cellular mobile telephony capabilities when the aircraft is entering U.S. airspace. The installed mobile telephone system should provide an automatic indication of U.S. airspace entry.

9.2.2 If the FCC revises the restrictions mentioned above, the switch-off procedures, necessary for entering U.S. airspace, will become invalid.

9.3 Procedures for Air-to-Ground Communication. Installed air-to-ground telephone systems may be used while airborne or on the ground. Such systems are installed, tested, and certified per FAA aircraft certification and airworthiness standards. The operator's procedures for using installed telephone systems should be clearly described in oral briefings prior to departure or in written material provided to each passenger.

10 CARGO-TRACKING DEVICES, DATA LOGGERS, RADIO FREQUENCY IDENTIFICATION (RFID), AND ELECTRONIC BAG TAGS.

This paragraph applies to PEDs designed for use on aircraft in locations inaccessible to the flightcrew during flight. Because this class of PEDs cannot be turned off manually in the event of an emergency, the aircraft operators must ensure certain design and operational considerations are addressed. The operator must ensure these PEDs meet the following criteria:

10.1 PED Design Information. The operator must obtain and review the following device manufacturer information to ensure certain design and operational considerations are addressed:

- Pictures of the device and peripherals;
- Product label;
- Operational description of device and peripherals;
- Manufacturer statement of strict design and production controls; and
- Battery design standard and relevant battery qualification documentation if the device contains a lithium battery. Examples of design standards and documentation are TSO-C142a, Non-Rechargeable Lithium Cells and Batteries, dated August 7, 2006, approval; IEEE 1625/1725 qualification; or other qualification report.

10.2 Emissions Limits and Peripheral Devices. During all modes of operation, the device meets the RF radiated emissions limits in RTCA DO-160, Environmental Conditions and Test Procedures for Airborne Equipment, Section 21, Category H. Testing must include peripheral devices used with the device during normal operations. Typically, peripherals are external sensors or associated wiring. For additional guidance, refer to RTCA DO-357, User Guide: Supplement to DO-160.

10.3 Means to Shut Off PED. If the test described in paragraph 10.2 fails or is not met, then the device must be designed with a minimum of two independent means to 1) turn off completely, 2) turn off cellular or mobile functions, or 3) a combination of both when airborne.

10.3.1 These independent means must identify different sources, when airborne. For example, a device designed to sense rapid altitude changes and acceleration to turn off cellular transmissions is an acceptable design containing two different sources. However, a device designed with two vertical accelerometers is not an acceptable design because the sources are not different.

10.3.2 The device may use low-powered wireless communications during flight without the need to comply with paragraph 10.2.1. RTCA DO-363 states: “[e]xperience shows that low-power emission levels do not affect aircraft systems. The low-power emission limit is 100mW EIRP (equivalent isotropic radiated power). Wireless communication standards which are limited to this level do not need to be analyzed for backdoor coupling. This includes Bluetooth (IEEE 802.15.1), ZigBee (IEEE 802.15.4). 100mW may be conservatively considered representative maximum operating power of normal in-band WLAN (IEEE 802.11) output power level in the 2.4GHz ISM band.” Operators should review WLAN (IEEE 802.11) device output power levels, because WLAN devices approved in the United States often have maximum output power that significantly exceeds 100mW EIRP.

10.4 Signals. The device must not emit disturbing signals, such as buzzing alarms or strobe lights, during transport.

10.5 PED Batteries. For batteries of devices, the FAA recommends a limit of 0.3 grams or less per lithium metal cell or 2.7 watt-hours per lithium ion cell.

11 MEDICAL-PORTABLE ELECTRONIC DEVICES (M-PED). This section applies to M-PEDs, devices medically necessary to support physiological functions, which passengers may use at all times, and do not need to be switched off.

11.1 Considerations for M-PEDs. The FAA believes sufficient risk mitigation can allow safe operation of M-PEDs during flight, yet does not prevent voluntary inclusion of M-PEDs in an operator's carry-on baggage program, general operating procedures manual, or personal items policy. The FAA encourages operators to include M-PEDs in their carry-on baggage program and personal items policy to increase air travel accessibility for people with disabilities. Some M-PEDs are life-sustaining and cannot be turned off during flight, but generally, M-PEDs have safely been in use for decades as part of emergency medical services and commercial operations. An airline's risk assessment and crewmember procedures must address proper stowage of larger M-PEDs and the need for certain M-PEDs to remain on during aircraft operations. Small M-PEDs must be secured during surface movement, takeoff, descent, approach, and landing; passengers should secure small M-PEDs on their person in an armband or garment pocket.

11.2 POCs. To comply with §§ 121.574(e)(1)(ii), 125.219(f)(1)(ii), and 135.91(f)(1)(ii), POC manufacturers must ensure their equipment does not interfere with electrical, navigation, or communication equipment on aircraft. When considering aircraft electromagnetic compatibility with POCs, the following are acceptable methods to allow unrestricted use of POCs:

- POC manufacturer-qualified radiated RF emissions testing;
- Electromagnetic compatibility testing for Class II medical devices intended for use in aviation by the Food and Drug Administration (FDA); or
- POC makes and models that either bear a label or are listed in § 121.574(e)(1)(v), 125.219(f)(1)(v), or 135.91(f)(1)(v). Include specific POC makes and models in an airline's carry-on baggage program and personal items policy.

11.3 Nondiscrimination Requirements. Air carriers should be aware of Department of Transportation (DOT) requirements in 14 CFR part 382 addressing the use of certain M-PEDs. More information on part 382 is at https://www.transportation.gov/airconsumer/passengers-disabilities.

12 HOW TO OBTAIN REFERENCED DOCUMENTS.

12.1 RTCA Documents. You may order RTCA documents via telephone at (202) 833-9339, fax at (202) 833-9434, or online at http://www.rtca.org. You may also order documents by mail from:

RTCA, Inc.
1150 18th Street NW, Suite 910
Washington, DC 20036

12.2 PED ARC Recommendation Report. You can find the PED ARC Recommendation Report at http://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/committee/browse/committeeID/337.

13 AC FEEDBACK FORM. For your convenience, the AC Feedback Form is the last page of this AC. Note any deficiencies found, clarifications needed, or suggested improvements regarding the contents of this AC on the Feedback Form.

John Barbagallo
Deputy Executive Director, Flight Standards Service

Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by contacting the Flight Standards Directives Management Officer at 9-AWA-AFS-140-Directives@faa.gov.

Subject: AC 91.21-1D, Use of Portable Electronic Devices Aboard Aircraft

Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:

_____

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☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

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☐ Other comments:

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Submitted by: _____ Date: _____