U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Authorization for Use of Electronic Flight Bags

Date: DRAFT **AC No:** 120-76E
Initiated by: AFS-400 **Change:**

1 **PURPOSE OF THIS ADVISORY CIRCULAR (AC).** This Flight Standards Service (FS) AC contains guidance on the operational use of Electronic Flight Bags (EFB). It is intended for all operators conducting flight operations under Title 14 of the Code of Federal Regulations (14 CFR) part 91 subpart K (part 91K), 121, 125, or 135 who want to replace required paper information or utilize other select applications as part of EFB functionality. This AC sets forth an acceptable means, but not the only means, to obtain Federal Aviation Administration (FAA) authorization for the operational use of EFBs utilizing either portable devices or installed equipment evaluated by the operator as their means to display aeronautical information with an equivalent level of accessibility, usability, and reliability to the means they replace. This AC will assist operators in starting and managing the required elements of an EFB program as a means to support their authorization for use. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way, and the document is intended only to provide information to the public regarding existing requirements under the law or agency policies.

Note: In this AC, "installed equipment" indicates equipment or EFB components, which are installation approved under aircraft type design. For guidance on the installation of EFB components, refer to AC 20-173, Installation of Electronic Flight Bag Components.

1.1 EFB Program. Operators seeking authorization under part 91K, 121, 125, or 135 may utilize the language within this AC to develop an EFB program. The program specifics (e.g., operating procedures, pertinent training modules, checklists, operations manuals, flight attendant (F/A) manuals, training manuals, maintenance programs, minimum equipment lists (MEL), other pertinent documents, reporting procedures, and cybersecurity concerns) are developed and incorporated into operator policy before the FAA grants authorization.

1.2 Requirements. This AC describes an acceptable means, but not the only means, for operators conducting flight operations seeking authorization for the operational use of EFB applications under part 91K, 121, 125, or 135. This AC is not mandatory and does not constitute a regulation. However, if you use the means described in this AC, you should follow it in all important respects.

2 AUDIENCE. This AC should be used by system designers, installers, and operators seeking design and use guidance for hosting EFB applications on both portable devices and installed equipment.

3 WHERE YOU CAN FIND THIS AC. You can find this AC on the FAA's website at https://www.faa.gov/regulations_policies/advisory_circulars and the Dynamic Regulatory System (DRS) at https://drs.faa.gov.

4 WHAT THIS AC CANCELS. This AC cancels AC 120-76D, Authorization for Use of Electronic Flight Bags, dated October 27, 2017.

5 SUMMARY OF CHANGES. This revision:

- Clarifies the definition of an EFB to underscore that an authorized device displaying Type A and/or Type B EFB applications is considered an EFB.
- Updates the definition of Type B applications to remove the requirement that Type B EFB applications be listed in an operator's operations specifications (OpSpec), management specifications (MSpec), or Letters of Authorization (LOA).
- Updates phraseology throughout to reflect use by crewmembers other than pilots.
- Adds verbiage to address situations when an EFB battery does not have manufacturer-recommended battery replacement intervals.
- Adds a 6-month retention period for records of change to an operator's EFB program.
- Adds applications to Appendix B, Type B Electronic Flight Bag (EFB) Applications.

6 WHAT IS AN EFB? An EFB is any authorized device, or combination of devices, actively displaying Type A and/or Type B EFB applications. EFBs are characterized by the following:

- An EFB hosts applications, which are generally replacing the conventional paper products and tools traditionally carried in a crewmember's flight bag. EFB applications include natural extensions of traditional flight bag contents, such as applications that replace paper copies of weather reports with access to near-real-time weather information.
- In order to qualify as an EFB application, the failure effect must be considered a minor hazard or have no safety effect.
- Acceptable EFB applications are listed in Appendix A, Type A Electronic Flight Bag (EFB) Applications, and Appendix B. These EFB applications may be overlaid or integrated.
- EFB applications cannot replace any installed equipment required by operational or airworthiness regulations.
- EFB applications have no certification requirements for installation under aircraft type design (refer to AC 20-173).

7 EFB APPLICATION TYPES. EFB applications are categorized as Type A or B, and can be hosted on either portable or installed components.

7.1 Type A Applications:

- Are listed in Appendix A;
- Have a failure condition classification considered to be no safety effect, as described in RTCA DO-178, Software Considerations in Airborne Systems and Equipment Certification;
- Do not substitute for or replace any paper, system, or equipment required by airworthiness or operational regulations; and
- Do not require specific authorization for use (i.e., although the Type A EFB application is part of the operator's EFB program, Type A EFB applications are not identified or controlled in the OpSpecs, MSpecs, or LOAs).

7.2 Type B Applications:

- Are listed in Appendix B;
- Have a failure condition classification considered minor, as described in RTCA DO-178;
- May substitute or replace paper products of information required for dispatch or to be carried in the aircraft;
- May not substitute for or replace any installed equipment required by airworthiness or operating regulations;
- Are authorized as part of the operator's FAA-authorized EFB program (Type B EFB applications are no longer identified or controlled in the OpSpecs, MSpecs, or LOAs.); and
- Are listed in the operator's EFB program catalog.

8 HOW CAN ADDITIONAL APPLICATIONS BE ADDED TO THE EFB APPLICATION LISTING? Appendices A and B identify accepted Types A and B applications. As new applications are developed, they may be qualified as an EFB application as long as their failure condition classification is agreed to by the FAA to be minor, or no safety effect, as described in RTCA DO-178. Proponents must provide their Functional Hazard Assessment (FHA) to the Flight Technologies and Procedures Division for evaluation and coordination.

9 HARDWARE SUPPORTING EFB APPLICATIONS. In the context of this AC, EFB equipment components supporting EFB applications are "installed" when they are incorporated into aircraft type design under 14 CFR part 21, or as a proper alteration under 14 CFR part 43, § 43.3. All other components supporting EFB functionality are considered "portable," regardless of how often they are removed from the aircraft. In order for portable EFB hardware to support EFB applications, installation of at least some

EFB components may be required, depending on requirements for positional integrity (e.g., installed mounts), continuity of power (e.g., dedicated primary power port), and data connectivity (e.g., Wireless Fidelity (WiFi) and Ethernet). Airworthiness regulations do not apply to portable EFB components other than for specifications associated with the installed components (e.g., mounting (size and weight), power (maximum electrical load, voltage, and current frequency), and data connectivity (input/output (I/O) data specifications and security)). Regardless, this AC is applicable to any portable EFB components (e.g., mount, display, external Global Positioning System (GPS), cables/cords/adapters, and portable wireless transmitters) supporting an applicant's authorization for use. Display of EFB applications on installed displays may require differentiation to enable the flightcrew member to distinguish between information provided by the installed avionics system and by the supplemental or "secondary" EFB system. Differentiation may be accomplished by visual or physical means or by a combination thereof. Visual differentiation may be accomplished by, but not limited to, unique borders, labels, and/or shading. Differentiation should not solely rely on the EFB application design, as similar designs could reside in both an EFB application and approved functions installed on the aircraft (i.e., the application cannot rely on itself for differentiation). Physical differentiation may be accomplished by, but not limited to, separate controls for the EFB and/or physical distance. For guidance on the design of installed components supporting EFB functionality, refer to AC 20-173. Crewmember training alone is not a sufficient means of differentiation.

9.1 Portable Electronic Device (PED). These devices are typically consumer commercial off-the-shelf (COTS) electronic devices functionally capable of communications, data processing, and/or utility. Refer to the PED Aviation Rulemaking Committee (ARC) Report, Recommendations on Expanding the Use of Portable Electronic Devices During Flight, September 2013 (available within the file at https://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/document/information/documentID/1062/). Compliance with PED regulations is further explained in AC 91.21-1, Use of Portable Electronic Devices Aboard Aircraft. The use of any PED in an aircraft is subject to compliance with PED regulations (part 91, § 91.21; part 121, § 121.306; part 125, § 125.204; and part 135, § 135.144) and must be evaluated by the user/operator prior to use to ensure the PED will not interfere in any way with the operation of aircraft. The definition of a PED is intended to encompass Transmitting Portable Electronic Devices (T-PED).

9.1.1 Portable EFB. Portable components supporting EFB applications are considered PEDs. For a PED to be considered an EFB, the PED must actively display Types A and/or B software application(s) (e.g., when a PED is displaying personal email, the PED is not considered an EFB; when the same PED is authorized and actively displaying a Type B aeronautical chart application, it is then considered an EFB).

Note: Section 121.542(d) (effective April 14, 2014) prohibits flightcrew members from using a personal wireless communications device or laptop computer for personal use while at their duty station on the flight deck while the aircraft is being operated, unless it is in accordance with FAA-approved operational procedures. This prohibition is intended to ensure nonessential activities do not

affect flight deck task management or cause a loss of situational awareness during aircraft operation (refer to FAA Information for Operators (InFO) 14006, Prohibition on Personal Use of Electronic Devices on the Flight Deck). Additionally, training of crewmembers on the use of portable EFBs should reinforce that when an authorized portable EFB actively displays a software application not covered in Appendices A and/or B, it is no longer functioning as a portable EFB and is considered a personal PED.

9.1.2 Portable EFB Hardware Components:

- Should be capable of being easily removed from or attached to their mounts by a crewmember without tools or maintenance action.
- Can be temporarily connected to an existing aircraft power port for battery recharging.
- May connect to aircraft power, data ports (wired or wireless), or installed antennas, provided those connections are installed in accordance with AC 20-173 and include provisions to prevent and mitigate Intentional Unauthorized Electronic Interactions (IUEI).

10 EVALUATION OF PORTABLE HARDWARE COMPONENTS.

10.1 Portable EFB Electromagnetic Compatibility (EMC) Demonstration. The certificate holder (CH)/operator must demonstrate that all portable EFB components, including cords/cables for data or power, are electromagnetically compatible with aircraft navigation and communication systems. One of the following three methods in paragraphs 10.1.1, 10.1.2, or 10.1.3 may be accomplished to demonstrate portable EFB EMC with aircraft for all phases of flight.

10.1.1 PED-Tolerant Aircraft (Method 1). Aircraft demonstrated as PED-tolerant for both transmitting and nontransmitting PEDs do not require specific aircraft EMC ground or flight tests. Aircraft PED tolerance may be demonstrated using guidance in AC 20-164, Designing and Demonstrating Aircraft Tolerance to Portable Electronic Devices. The aircraft PED tolerance determination under AC 20-164 must be based on data approved by a responsible Aircraft Certification Service office. Aircraft operators who have performed a PED Safety Risk Assessment (SRA) in accordance with RTCA DO-363, Guidance for the Development of Portable Electronic Devices (PED) Tolerance for Civil Aircraft, and determined specific aircraft models were certified as PED-tolerant in accordance with RTCA DO-307, Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance, require no further portable EFB EMC ground or flight tests for those aircraft.

10.1.2 Aircraft Operator PED SRA (Method 2). Aircraft operators may choose to expand their policies covering the use of PEDs for all phases of flight in accordance with RTCA DO-363. Aircraft operators who have successfully completed the PED SRA in RTCA DO-363 and allow unrestricted PED use throughout all phases of flight do not have to complete portable EFB EMC-specific ground or flight tests.

10.1.3 Aircraft EMC Tests (Method 3). The CH/operator should use this method if the operator's aircraft are not determined to be PED-tolerant in paragraph 10.1.1 above or the aircraft operator's PED SRA in paragraph 10.1.2 requires limitations on PED use.

10.1.3.1 Radio Frequency (RF) Emissions. The CH/operator should obtain the RF emissions characteristics of the PED through RTCA DO-160, Environmental Conditions and Test Procedures for Airborne Equipment, Section 21, Emission of Radio Frequency Energy; RF emissions tests; or an equivalent RF emissions test standard. The CH/operator should use the emission limits in Categories L, M, or H from RTCA DO-160, Section 21. Tests using the limits in Category B from RTCA DO-160, Section 21 are not sufficient because they provide very little assurance the EFB PED will not interfere with aircraft radios, electrical systems, or electronic systems. Experience has shown successful qualification using these categories provides high assurance the equipment will not interfere with aircraft radios or other aircraft electrical or electronic equipment or systems.

10.1.3.2 Charging Tests. If the aircraft operator intends to allow charging of its portable EFB during flight, then the test setup should include testing under charging conditions. If the aircraft operator intends to allow its portable EFB to charge in flight and does not have RF emissions test data, then the operator will need either to retest the PED under the charging conditions or perform EMC ground tests according to paragraph 10.1.3.3 below.

10.1.3.3 EMC Ground Tests. Perform aircraft EMC ground tests if the PED's RF emissions test data reveals potential for interference or if the operator lacks complete RF emissions data during all intended operating conditions. Configure the aircraft as prepared for taxi with doors and access panels closed and ground-based electrical power disconnected. Power for the aircraft electrical and electronic systems should be from the aircraft generator(s) during testing. A PED as EFB Electromagnetic Compatibility (EMC) Assessment checklist has been developed and is located in the DRS at https://drs.faa.gov/.

Note: The aircraft EMC ground tests demonstrate portable EFB EMC with aircraft navigation and communication systems for each aircraft make, model, and series (M/M/S) in which the portable EFB will operate. Operate the specific portable EFB equipment on the aircraft to show no interference occurs with aircraft equipment. The aircraft EMC tests should demonstrate RF emissions from the equipment do not interfere with safety-related aircraft systems, particularly aircraft radio receivers, and aircraft systems required by regulations, such as flight data recorders (FDR). These EMC tests are based on a source-victim matrix, where the portable EFB is the potential source of interference and the safety-related aircraft systems and aircraft systems required by regulations are the potential victim systems. The operating modes for the portable EFB and the potential interference victim systems are

defined in the source-victim matrix. Special test equipment might be required to simulate in-flight operating conditions.

10.1.3.3.1 If RF emissions tests have been performed using RTCA DO-160, Section 21, select the aircraft radio receiver channels based on inspection of the emissions test results in the aircraft radio receiver frequency bands.

10.1.3.3.2 Certain radio receivers with no direct indication of receiver performance, such as transponders and Global Navigation Satellite Systems (GNSS), might require specific procedures or instrumentation to determine acceptable performance.

10.1.3.3.3 If the portable EFB includes a transmitter, such as a WiFi, cellular, or Bluetooth® transmitter, demonstrate that the portable EFB transmitter will not adversely affect other aircraft systems during the aircraft EMC ground tests. Configure the portable EFB transmitters to operate at their maximum RF output power during the aircraft EMC ground tests.

10.1.3.3.4 If the portable EFB will connect to the aircraft for power or battery charging, then perform the EMC ground tests with the portable EFB connected to the aircraft power source.

10.1.3.4 Aircraft EMC Flight Tests. If EMC ground tests conducted under paragraph 10.1.3.3 cannot adequately simulate the in-flight environment, or when the systems being evaluated for susceptibility cannot be operated on the ground, then conduct additional EMC flight-testing.

Note: EMC flight-testing, if necessary, should be conducted during visual meteorological conditions (VMC).

10.2 Rapid Decompression Testing.

10.2.1 Representative Sample. To provide some level of assurance of functional capability during a decompression event, decompression testing must be accomplished on representative samples of powered EFB component make and model configurations. It is the responsibility of the operator to provide documentation showing these tests were accomplished on at least one representative sample of each make and model of powered EFB component. Representative testing is an appropriate level of testing for modern solid-state devices. The testing of operational EFBs should be avoided when possible to preclude the infliction of unknown damage to the unit during testing.

10.2.2 Rapid Decompression Testing. Rapid decompression testing must be accomplished for authorization of EFBs in pressurized aircraft in order to confirm the representative sample is safe during a rapid decompression event in close proximity to the flightcrew member and remains available for operational use. The information from the rapid decompression test is used to establish the procedural requirements for the use of the EFB in a pressurized aircraft. Rapid decompression testing must comply with RTCA DO-160, Section 4, Temperature and Altitude, guidelines for rapid decompression testing up to the

maximum operating altitude of the aircraft in which the EFB is to be used. Similarity of a particular EFB make and model to a unit already tested may be used to comply with this requirement. It is the responsibility of the operator to provide the rationale for the similarity.

10.3 Electrical Power Source. EFB design should consider the source of electrical power, the independence of the power sources for multiple EFBs, and the potential need for an independent battery source. Battery-powered EFBs having aircraft power available for recharging the EFB battery are considered to have a suitable backup power source. For recharging, the operator should establish a procedure to ensure safe recharge of the battery. EFBs not having a battery power source should be connected to an aircraft power source. For guidance on the design and installation of aircraft electrical power sources, refer to AC 20-173. If an operator chooses to use portable chargers, or power banks, to charge EFBs during flight operations, additional safety considerations should be taken into account. Portable charger stowage, cord placement, proximity to flammables (e.g., oxygen system components), and power supplied are some potential concerns.

10.3.1 Battery-Powered EFBs. Useful battery life should be established and documented for battery-powered EFBs. Each battery-powered EFB providing Type B EFB applications should have at least one of the following before departing on a flight:

- An established procedure to recharge the battery from aircraft power during flight operations;
- A battery or batteries with a combined useful battery life to ensure operational availability during taxi and flight operations to include diversions and reasonable delays considering duration of flight; or
- An acceptable mitigation strategy providing availability of aeronautical information for the entire duration of flight authorized by the FS office with certificate oversight responsibility.

10.3.2 Battery Replacement. Battery replacement intervals should meet or exceed the Original Equipment Manufacturer (OEM) recommendations. If the EFB manufacturer has not specified a battery replacement interval, then the original battery (or cell) manufacturer's specified replacement interval should be followed. If no recommended battery replacement intervals exist or if the battery is designed to last for the life of the EFB, the operator should continue to monitor the useful battery life for the EFB.

10.3.3 Lithium Batteries. Rechargeable lithium-type batteries are becoming more common as a source of principal power or standby/backup power in EFBs. Lithium-ion or lithium polymer (lithium-ion polymer) batteries are two types of rechargeable lithium batteries commonly used to power EFBs. The word "battery" used in this AC refers to the battery pack, its cells, and its circuitry.

10.3.3.1 Safety Concerns. These types of batteries are vulnerable to internal short circuiting from overcharging, damage, over-discharging, etc. Internal short circuiting may result in thermal runaway, which can cause the release of

smoke, heat, hazardous gases, and flames. Once one cell in a battery pack goes into thermal runaway, it can produce enough heat to cause adjacent cells to go into thermal runaway. The resulting fire can flare repeatedly as each cell ruptures and releases its contents. For guidance on fighting fires caused by lithium-type batteries in PEDs, refer to AC 120-80, In-Flight Fires, and Safety Alert for Operators (SAFO) 09013, Fighting Fires Caused by Lithium Type Batteries in Portable Electronic Devices. A lithium battery fire has the potential to damage oxygen system components, causing the release of oxygen gas, which can intensify the fire. Therefore, consideration should be given to the proximity of the EFB and portable chargers to components of the oxygen system, as applicable.

10.3.3.2 Design Recommendation. We recommend the rechargeable lithium-type battery design be compliant with the provisions of Institute of Electrical and Electronic Engineers (IEEE) 1725-2021, IEEE Standard for Rechargeable Batteries for Mobile Phones. This standard drives design considerations for system integration, cell, pack, host device, and total system reliability. It also covers how to maintain critical operational parameters with respect to time, environment, extremes in temperature, and the management of component failure.

10.3.3.3 Related Regulations. There are other regulations applicable to the carriage and transport of lithium batteries onboard aircraft, including the Department of Transportation (DOT) regulations found in 49 CFR parts 171 through 180 (Hazardous Materials Regulations (HMR)). Specifically, part 175, § 175.10 contains exceptions for passengers, crewmembers, and air operators. Those regulations limit the lithium content for lithium metal batteries or Watt-hours (Wh) for lithium-ion batteries offered/carried for air travel. Additional information can be found at https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-C/part-175/subpart-A/section-175.10. The HMR apply to the preparation, offer, and transportation of all lithium-ion batteries and lithium metal batteries, including, but not limited to, batteries installed in PEDs. However, if spare batteries are carried, they must be sufficiently protected, in carry-on baggage only, and forbidden in checked baggage. Operators should refer to the current DOT regulations and their own policy manuals for any additional restrictions.

10.3.3.4 Lithium Battery Safety and Testing Standards. Due to their proximity to the flightcrew and potential hazard to the safe operation of the aircraft, the use of rechargeable lithium-type batteries in portable EFBs and portable chargers located in the aircraft flight deck calls for the batteries to meet industry safety standards. Operators should obtain evidence of the following testing standards to determine whether rechargeable lithium-type batteries used to power and recharge EFBs are acceptable for use. Operators should obtain evidence of the standards in paragraphs 10.3.3.4.1 and either 10.3.3.4.2, 10.3.3.4.3, or 10.3.3.4.4:

10.3.3.4.1 United Nations (UN) Transportation Regulations. UN Manual of Tests and Criteria (ST/SG/AC.10/11).

10.3.3.4.2 Underwriters Laboratory (UL). UL 1642, Standard for Lithium Batteries; UL 2054, Standard for Household and Commercial Batteries; and UL 60950-1, Information Technology Equipment - Safety - Part 1: General Requirements.

Note: Compliance with UL 2054 indicates compliance with UL 1642.

10.3.3.4.3 International Electrotechnical Commission (IEC). International Standard IEC 62133, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications.

10.3.3.4.4 RTCA DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Batteries and Battery Systems. An appropriate airworthiness testing standard, such as the RTCA DO-311, can be used to address concerns regarding overcharging, over-discharging, and the flammability of cell components. RTCA DO-311 is intended to test permanently-installed equipment; however, these tests are applicable and sufficient to test EFB rechargeable lithium-type batteries. For further guidance on RTCA DO-311 testing, refer to AC 20-184, Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft.

10.3.3.5 Showing Compliance. The operator should possess records showing compliance to these battery standards during the authorization to use the EFB. These records may be available from the EFB manufacturer or the battery's OEM.

10.3.3.6 Rechargeable Lithium-Type Battery Maintenance, Storage, and Functional Check. Operators should have documented maintenance procedures for their rechargeable lithium-type batteries. These procedures should meet or exceed the OEM's recommendations. These procedures should address battery life, proper storage and handling, and safety. There should be methods to ensure the rechargeable lithium-type batteries are sufficiently charged at proper intervals and have periodic functional checks to ensure they do not experience degraded charge retention capability or other damage due to prolonged storage. These procedures should include precautions to prevent mishandling of the battery, which could cause a short circuit, damage, or other unintentional exposure, or possibly result in personal injury or property damage. All replacements for rechargeable lithium batteries should be sourced from the OEM and repairs should not be made.

10.4 Use of Aircraft Electrical Power Sources. Appropriate labels should identify the electrical characteristics (e.g., 28 volts direct current (VDC), 1,500 milliamps (mA), 60 or 400 hertz (Hz)) of electrical outlets for portable EFB electrical connections. Conduct an

electrical load analysis (ELA) to replicate a representative EFB device to ensure powering or charging the EFB will not adversely affect other aircraft systems and power requirements remain within power load budgets. Additional actions and application of airworthiness regulations are not applicable to the internal elements of portable EFBs unless specified in this AC. For guidance on the use of aircraft electrical power sources, refer to AC 20-173.

10.5 EFB Stowage. Stowage requires an inherent means to prevent unwanted EFB movement. EFB stowage is required for all portable EFBs, cables, cords, portable batteries, and other EFB accessories not secured in or on a mounting device. If an EFB mounting device is not provided (via viewable stowage or installed mounts), then designate an area to securely stow the EFB. Do this in a manner to prevent the device and/or EFB accessories from jamming flight controls, damaging flight deck equipment, interfering with cabin safety equipment, or injuring crewmembers should the device move about because of turbulence, maneuvering, or other action. The stowage area must not obstruct visual or physical access to controls, emergency equipment, and/or displays, crewmember ingress or egress, or external vision. An acceptable stowage location for a portable EFB, cables, cords, portable batteries, and other EFB accessories with no mount includes the inside compartments of the crewmember's stowed flight bag.

10.5.1 Viewable Stowage Devices and Components. A viewable stowage device is a portable device or component used to secure portable EFB hardware, which allows the crewmember to continue viewing the EFB display (e.g., kneeboards, suction cups, and removable trays). Viewable stowage solutions must not interfere with flight control movement, obstruct visual or physical access to controls and/or displays, interfere with cabin safety equipment, or obstruct ingress or egress. Viewable stowage should minimize blockage of the windshields and windows to allow crewmembers to maintain a clear view of critical outside references (e.g., during ground operations, taxiing, takeoff, approach, landing, and emergency evacuation). Training and procedures must address specific and acceptable placement of viewable stowage devices. Cables, cords, portable batteries, and other EFB accessories must also not interfere with flight control movement, obstruct visual or physical access to controls and/or displays, interfere with cabin safety equipment, obstruct ingress or egress, or obstruct visibility outside of the aircraft. For further guidance on pilot compartment visibility, refer to AC 25.773-1, Pilot Compartment View Design Considerations.

11 EFB DESIGN CONSIDERATIONS.

11.1 Integrity Considerations. Information contained in the data files should be of sufficient integrity to perform the intended use without producing false or hazardously misleading information. It is subsequently maintained through data updates, software revision procedures, crewmember feedback, and operational oversight. A process for continuous fault or anomaly reporting by the users is essential to an effective EFB program. This is initially accomplished through the evaluation process and the demonstration period.

11.2 Usability. It is necessary to evaluate the human factors (HF)/crewmember interface characteristics of the EFB. Special attention should be paid to new or unique features

affecting crewmember performance. The EFB user interface should be consistent and intuitive within and across various EFB applications. The interface design (including, but not limited to, data entry methods, color-coding philosophies, terminology, and symbology) should be consistent across the EFB applications. The information displayed on the EFB should be provided in a clear and unambiguous manner. EFB applications should not cause a distraction (through visual or audible notifications) to the crewmember. EFB applications should be evaluated on the specific EFB platform intended for use by an operator to verify the presentation of the information is consistent.

11.3 Legibility. Information displayed on the EFB should be legible to the typical user at the intended viewing distance(s) and under the full range of lighting conditions expected on an aircraft, to include daytime use in direct sunlight and night operations. This is especially important when night operations require night vision goggle (NVG) compatible light sources. Users should be able to adjust the screen brightness of an EFB independently of the brightness of other displays on the flight deck. Brightness should be adjustable in fine increments. In addition, when incorporating an automatic brightness adjustment, it should operate independently for each EFB on the flight deck. Consideration should be given to long-term display degradation because of abrasion and aging. The EFB should not produce objectionable glare or reflections that adversely affect the crewmember's visual environment. When using an EFB in NVG operations, use of filters (temporary or permanent) for night vision compatibility is acceptable, as long as they do not degrade the EFB functionality in other lighting conditions. For further guidance on NVG compatibility, refer to AC 27-1, Certification of Normal Category Rotorcraft (Miscellaneous Guidance (MG) 16, Certification Guidance for Rotorcraft Night Vision Imaging System (NVIS) Aircraft Lighting Systems); AC 29-2, Certification of Transport Category Rotorcraft (MG 16); and/or RTCA DO-275, Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment.

11.4 Responsiveness of Application. The EFB should provide clear, unambiguous, and positive feedback to the user to indicate when user input is accepted. If the EFB is busy for an atypical time with internal tasks precluding immediate processing of user input (e.g., calculations, self-test, or data refresh), the EFB should display a "system busy" indicator (e.g., clock icon) to inform the user the system is occupied and cannot process inputs immediately. The timeliness of system response to user input should be consistent with an application's requirements for operational use and the associated crew task. The feedback and system response times should be predictable to avoid crewmember distractions and/or uncertainty.

11.5 Off-Screen Text and Content for Cursor Control Devices. If the document segment is not visible in its entirety in the available display area, such as during "zooming" or "panning" operations, the existence of off-screen content should be clearly indicated in a consistent way. For some applications, it may be unacceptable if certain portions of documents are not visible. The basis of this evaluation should be on the application and intended operational use. If there is a cursor, it should be visible on the screen at all times while in use. The default position should be easily accessible after any active manipulation (e.g., zooming, panning, or decluttering).

11.6 Active Regions. Active regions are regions to which special user commands apply. The active region can be text, a graphic image, a window, a frame, or another document object. If the display uses active regions, these regions should be clearly indicated.

11.7 Managing Multiple Open Applications and Documents. The EFB application should provide continuous indication of which application and/or document is active if the system supports multiple open documents, or if the system allows multiple open applications. The active application/document is the one currently displayed and responding to user actions. Under nonemergency, normal operations, the user should be able to select which of the open applications or documents is currently active. In addition, the user should be able to find which open in-flight applications are running and switch to any one of these open applications easily. The user should also be able to open a new application quickly and easily. When the user returns to an application running in the background, it should appear in the same state as when the user left the application, other than differences associated with the progress or completion of processing performed in the background.

11.8 Controls. All controls must be within reach and view of the appropriate flightcrew member from their normally seated position on the flight deck. The EFB must not visually obstruct other controls and instruments. In choosing and designing input devices, such as keyboards, touch screens, or cursor-control devices, operators should consider the type of entry to be made and flight deck environmental factors, such as turbulence and other normal vibrations affecting the usability of the input device. For touch screens, pilots may need physical locations or structures (e.g., armrests) to stabilize their arm, hand, and fingers in order to make accurate inputs. Ensure touch screens do not result in unacceptable levels of pilot workload and error rates. The performance parameters of cursor-control devices are typically tailored for the application requirements as well as for the flight deck environment. Input devices should provide feedback to indicate when they are operational. Since touch screens provide little or no tactile feedback or control motion, visual and/or aural or other touch activation feedback is especially important. Other touch screen considerations include selecting the touch technology (e.g., resistive or capacitive), controlling screen contaminates which may reduce readability (e.g., skin oils or perspiration), and mitigating inadvertent operation. For further guidance on EFB controls, refer to AC 20-175, Controls for Flight Deck Systems.

11.9 System Error Messages. If an application is fully or partially disabled, or is not visible or accessible to the user, it may be desirable to have a positive indication of its status to the user upon request. Messages should be operationally relevant and limited to minimize the adverse effects on crewmember workload. EFB status and fault messages should be prioritized, and the message prioritization scheme evaluated and documented. When displaying messages, and there are additional messages in the queue not currently displayed, there should be an indication of additional messages.

11.10 Data Entry Screening and Error Messages. If user-entered data is not of the correct format or type needed by the application, the EFB should not accept the data. The EFB should provide an error message clearly communicating to the crewmember which entry is suspect and specifying what type of data it expects. The EFB and application software

should incorporate input error checking to detect input errors at the earliest possible point during entry, rather than on completion of a possibly lengthy invalid entry.

11.11 Error and Failure Modes.

11.11.1 Crewmember Error. The system should be designed to minimize the occurrence and effects of crewmember error and enable the crewmember to detect and manage errors when they occur. For example, terms for specific types of data or the format for entry of latitude/longitude should be the same across systems. Data entry methods, color-coding philosophies, and symbology should be as consistent as possible across the various hosted EFB applications. The possible effects of undetected errors in each EFB application should be evaluated. The evaluation should address the adequacy of the user interface, accessibility of controls, ability to view controls, annunciations, displays and printers, and the effect on flightcrew workload and head-down time. The evaluation should also consider the effects of crewmember (procedural) errors determined by feedback from crewmembers.

11.11.2 Identifying Failure Modes. The EFB should be capable of alerting the crewmember of probable EFB application/system failures.

11.12 Crewmember Workload. The EFB software design should minimize crewmember workload and flightcrew head-down and/or eyes-in time. The positioning (e.g., location and viewing angle), use, and stowage of the EFB should not result in unacceptable crewmember workload. Avoid complex, multi-step data entry tasks during taxi, takeoff, descent, approach, landing, and non-cruise phases of flight. An evaluation of EFB applications should include a qualitative assessment of incremental pilot workload, related to the use of the EFB applications in isolation, as well as the use of those applications concurrent with other aircraft system interfaces and their safety implications. If EFB functionality includes use during taxi, takeoff, descent, approach, landing, non-cruise phases of flight, or abnormal and emergency operations, its use should be evaluated during simulated or actual aircraft operations under those conditions.

11.13 Electronic Display of Aeronautical Charts.

11.13.1 Similarity to Paper. Electronic aeronautical charts should provide a level of information comparable to paper charts.

11.13.2 Legibility. Visual, instrument, and aerodrome charts (refer to International Civil Aviation Organization (ICAO) Annex 4, Aeronautical Charts) should contain the information necessary, in appropriate form, to conduct the operation at a level of safety at least equivalent to the reliability provided by paper charts. The screen size and resolution must be demonstrated to display information in a comparable manner to paper aeronautical charts and the data it is intended to replace. The information should be equally readable to the paper chart it is replacing, in both light and dark conditions.

11.13.3 Screen Size Considerations. As Type B applications, the screen must be capable of displaying an instrument approach procedure (IAP) chart in an acceptable aeronautical chart format similar to a published paper chart. As Type B applications, the screen must

be large enough to show the entire standard format, one-page IAP chart all at once, with a degree of legibility and clarity equivalent to the paper chart being replaced. This requirement is not meant to preclude panning and zooming features, but is intended to prevent a workload increase during the approach phase of flight. Alternate representations of IAP charts will need to be evaluated for operational suitability by the Aircraft Evaluation Division for functionality and HFs.

11.13.4 Aeronautical Charts. Aeronautical navigation charts (e.g., visual flight rules (VFR) navigation charts, low- and high-altitude en route charts, and terminal procedure publications) require evaluation for operational suitability. Panning, scrolling, zooming, rotating, or other active manipulation is permissible for these Type B applications for meeting legibility requirements. An EFB display might not be capable of presenting an entire aerodrome chart (airport diagram) if the chart is the expanded detail (fold over) type. In this case, a moving map-centering feature may be desirable. As Type B applications, aerodrome charts must include all information useful for airport operation. Any active manipulation (e.g., zooming, panning, or decluttering) should be easily returned to the default position.

11.14 Flight Standardization Board Reports (FSBR)/Operational Suitability Reports (OSR). FSBRs/OSRs addressing the use of various EFB applications may be available.

11.15 Applications Supported by Data Link.

11.15.1 Meteorological Information (MET)/Aeronautical Information Service (AIS) Products. Data link-supported EFB applications may display approved sources of weather for strategic/flight planning purposes. Weather and aeronautical information, such as data-linked MET and AIS products, are for advisory use only. These products are intended to enhance situational awareness, but lack the service delivery reliability and updating necessary for tactical maneuvering/use. Data-linked MET and AIS products are not intended for making tactical in-flight decisions regarding flight safety when avoiding adverse weather, airspace, or obstacle hazards (e.g., negotiating a path through a weather hazard area). Instead, current data-linked MET and AIS products support strategic decision making (e.g., route selection to avoid a weather hazard area in its entirety) and flight planning. For further guidance on the use of MET and AIS products, refer to AC 00-63, Use of Flight Deck Displays of Digital Weather and Aeronautical Information.

11.15.2 Graphical Weather Information. Data link graphical weather from sources such as XM radio and Next Generation Weather Radar (NEXRAD) may be from approved sources of advisory weather information and are only intended to be used for strategic/flight planning purposes. Data link graphical weather information is not intended to be used for tactical decisions because data quality is uncontrolled for aviation use. Data link graphical weather data is not intended to be used as a substitute for airborne weather radar or thunderstorm detection equipment. To qualify as a Type B application, graphical weather information should include a clear indication to the crew about the age of the information.

11.16 Database Accuracy and Quality. Database errors can have a significantly greater impact on the crewmember than other elements of the EFB. With this in mind, the EFB should have a database with appropriate quality control (QC) systems, and should be based on accuracy standards to avoid the potential presentation of hazardously misleading information. When developing the database and data quality requirements, we recommend the use of RTCA DO-200, Standards for Processing Aeronautical Data. Databases utilizing raster aeronautical charts should use the guidance in RTCA DO-257, Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps, Appendix F, to determine the level of accuracy and resolution supported, as well as guidance on the appropriate use of colors for raster aeronautical charts. A means to identify the database version, effective date, and valid operating period should be provided. For Type B applications displaying EFB own-ship position intended for airport surface operations, the airport map database should have an accuracy of 5 meters or less. However, if more accurate data is not available, the database accuracy should not exceed 30 meters. Combined with a maximum position source error, which is equivalent to an installed GNSS source, the total error budget for position source is 50 meters. The 50-meter accuracy value is approximately half of the separation of taxiways at aerodrome code letter E, as specified in ICAO Annex 14, Aerodromes. A statement of the QC processes applied and database accuracy by the database manufacturer should suffice for determination of database error contribution to the total error budget.

11.17 Display of EFB Own-Ship Position. EFB own-ship position on an EFB should only be displayed when the installed flight display, weather display, traffic display, or map display also depict own-ship position. For installed EFB displays, refer to AC 20-173 for additional guidance.

11.17.1 Proper Use of EFB Own-Ship. Operators should ensure flightcrew members understand the proper use of EFB own-ship position, including the need for concurrent use with certified avionics own-ship depiction. Operators should also ensure that flightcrew members understand the means of differentiation in order to distinguish between information provided by the certified avionics system and information provided by the supplemental or "secondary" EFB system. The flightcrew's reference for maneuvering the aircraft in the air is the certified primary flight and navigational displays. Therefore, flightcrew members should be able to quickly resolve own-ship conflicts between the EFB information depicted by the "secondary" system and the primary, certified avionics system during in-flight use. For EFB own-ship position use in ground operations, the use of external visual references (e.g., airport signs and markings) is sufficient for maneuvering the aircraft.

11.17.2 EFB Own-Ship Display Supporting Recommendations.

11.17.2.1 Position Source Selection. Use position data from an installed GNSS source. Portable equipment is more likely to experience signal blockage, signal degradation, and performance degradation. Position data from a portable GNSS source may be acceptable, but for consistency of availability, we

recommend the operator select an external GNSS source rather than the GNSS internal to the portable EFB.

11.17.2.2 EFB Own-Ship Directionality. Change own-ship to a nondirectional (circular) depiction when track or heading is not available.

11.17.2.3 EFB Own-Ship GNSS Data Stream. Remove EFB own-ship if the position becomes unavailable or is insufficient for the application. This will guard against a "frozen" own-ship condition caused by position source signal or power loss and removal should take no more than 3 seconds.

11.17.2.4 EFB Own-Ship Surface Use Accuracy. For airport map applications, choose a database with an accuracy of 5 meters or less. For airports where such data is not currently available, a database accuracy of up to 30 meters can still be operationally useful. If the database accuracy exceeds 30 meters, do not display EFB own-ship position.

Note 1: Applicants should contact their EFB airport map application provider to obtain the accuracy of their database. This information is usually found in documentation supporting the EFB airport map application.

Note 2: To qualify as a Type B EFB application, the use of own-ship position on the airport surface display is based on compliance with the operational guidelines in AC 120-74, Parts 91, 121, 125, and 135 Flightcrew Procedures During Taxi Operations.

11.17.2.5 Map Zoom. Design the application to indicate the current level of zoom or scale of the display. The design should ensure the zoom level is compatible with the position accuracy of the own-ship symbol.

11.18 Performance/Weight and Balance (W&B) Applications.

11.18.1 W&B. Type B applications for W&B are based on the existing information found in the FAA-approved Airplane Flight Manual (AFM), pilot's operating handbook (POH), or W&B manual for an aircraft. Type B W&B applications use data management software to provide data reference and mathematical calculations to simplify determination of aircraft W&B. To qualify as a Type B application, W&B applications must adhere to existing approved data and be validated for accuracy in the entire aircraft-operating envelope. Type B W&B applications may use algorithms to calculate W&B results or use basic mathematics combined with data spreadsheets to determine W&B results. Algorithms may have the ability to interpolate within approved data, but must not extrapolate, and therefore must be tested and proven accurate by the manufacturer or operator to represent the approved data. Type B W&B applications are produced for a specific aircraft and based on FAA-approved AFM data.

11.18.2 Performance Applications. Type B applications for performance are based on existing published data found in the FAA-approved AFM, POH, or performance manual for an

aircraft. Type B performance applications use data management software to provide data reference and mathematical calculations to simplify the determination of applicable aircraft performance data. To qualify as a Type B application, performance applications must adhere to this published data and be validated for accurate determination of aircraft performance for the entire operating envelope. Type B aircraft performance applications may use algorithms to calculate results or use basic mathematics combined with data spreadsheets to determine results. Algorithms may have the ability to interpolate within approved data, but must not extrapolate beyond the information contained in the current published data. These algorithms must be tested and verified to meet existing FAA-approved AFM performance data. Type B performance applications must not extrapolate or project results not represented by the FAA-approved AFM data point's envelope of conditions including, but not limited to, pressure, altitude, temperature, and weight. Type B aircraft performance applications are produced for a specific aircraft type based on FAA-approved AFM data.

11.18.3 Testing Performance and W&B Applications. To qualify as a Type B application, W&B and/or performance applications require demonstration testing prior to EFB operational use. Applications using data spreadsheets where each data point is entered into software data and then referenced for output must be verified for accurate data selection. Applications based on algorithms calculating their output must be verified to accurately represent the AFM data they replace. Creation of a new algorithmic method to replace AFM data is not allowed in Type B applications. Type B algorithms must adhere to the same data methodology as the FAA-approved AFM data. The Type B application must always be demonstrated to be traceable to the FAA-approved AFM data. These Type B applications must not perform calculations or provide output when the user makes an entry input which is outside the AFM data envelope(s). Sufficient data points based on application architecture must be tested and documented to show the applications accurately adhere to and are limited to the FAA-approved AFM data envelope segments and, for performance, must represent net climb gradients with considerations including, but not limited to, level-off, acceleration, transitions, and engine takeoff power time limits. Type B applications for performance must accurately address engine inoperative gradients and obstacle clearance plane and/or weight limits. Transition from airport area performance to en route climb performance and obstacle clearance must be addressed. Type B applications are suitable only insofar as they accurately reproduce the AFM data.

12 EFB PROGRAM COMPONENTS. A part 91K, 121, 125, or 135 operator must have an EFB program authorized by OpSpec/MSpec/LOA A061, Electronic Flight Bag (EFB) Program, in order to use EFB applications on either portable or installed equipment in-flight operations. EFB program specifics (e.g., operating procedures, maintenance procedures, administrative procedures, and training modules) should be developed, as applicable, and be available to the FAA. FAA authorization for an EFB program will be granted upon successful evaluation of an applicant's program operation.

12.1 Paper Removal. If an operator has an EFB program authorized with adequate mitigations or develops adequate mitigations as a modification to an existing program, it is possible to remove some paper products from the aircraft using an equivalent level of safety (ELOS). An operator proposing to remove paper from the aircraft should have

program mitigations in place to prevent an EFB failure resulting in the loss of any aeronautical information required for the operation of the flight. Although this AC categorizes EFB applications into Types A and B, required aeronautical information is defined by regulation and legal interpretations outside the scope of this AC. This requirement applies to paper removal for any crewmember, not only the pilot or copilot.

Note: Electronic checklists (ECL), including normal, abnormal, and emergency, may be presented as an EFB function; however, a current paper backup checklist may be required by an equipment manufacturer to be carried on board the aircraft and be readily accessible to the crew.

12.2 Operational Procedures.

12.2.1 Operational Procedures for EFB Hardware and EFB Applications. EFB programs should contain operational procedures for the use of EFB hardware and EFB applications in the aircraft. These procedures should define the roles of the flightcrew, cabin crew, and dispatch/flight following, including but not limited to:

- Procedures defining expectations of how the crewmember must use each EFB application during ground operations and under all flight conditions.
- Procedures defining how the crewmember will report irregularities of EFB hardware or EFB applications and how the operator will modify those existing policies and procedures based on crewmember feedback.
- Procedures for normal, abnormal, and emergency use by crewmembers.
- Procedures for notifying crewmembers and dispatch/flight following of any changes to the EFB program.

Note 1: Normal procedures should address an EFB's preflight and/or flight planning use, in-flight use/stowage/power assurance, and shutdown procedures.

Note 2: Normal procedures should include preflight inspection of a portable and/or battery-powered EFB's physical condition, including bulging, dents, cracks, or other damage that may indicate a potential EFB failure or, if applicable, a potential lithium-type battery fire.

12.2.2 Procedures and Training for Using EFBs with Other Flight Deck Systems. Procedures and training should address the actions to take when information provided by an EFB does not agree with other flight deck sources or when one EFB disagrees with another. Procedures and training should address applicable aircraft type design considerations when an EFB is simultaneously displaying information with existing avionics displays and procedures must identify which information source will be primary and which source will be secondary. Ultimately, procedures and training should ensure the flightcrew member understands which system to use for a given purpose, especially when installed avionics and EFBs (either portable or installed) are providing similar information.

12.2.3 Crewmember Awareness of EFB Software/Database Revisions. The operator should have a procedure in place to allow crewmembers to confirm the revision numbers and/or dates of EFB flight databases and software installed on their units for each flight. An example of a date sensitive revision is an aeronautical chart database on a 28-day revision cycle. Procedures should specify what action to take if the applications or databases loaded on an EFB are out of date.

Note: Databases not adversely affecting flight operations, such as maintenance log forms, a list of airport codes, or a captain's atlas, do not require the confirmation of revision dates by crewmembers.

12.2.4 Procedures to Mitigate and/or Control Workload. Procedures should mitigate and/or control additional workloads created by using an EFB.

12.2.5 Defining Responsibilities for Performance/W&B Calculations. The operator should develop procedures defining any new roles the flightcrew member and dispatch may have in creating, reviewing, and using performance/W&B calculations supported by EFBs.

12.3 Administrative Procedures.

12.3.1 EFB Program Modifications. An EFB program should have processes in place to identify and evaluate minor hardware and software modifications in accordance with the guidelines described in this AC. Minor program changes include:

- Adding/updating Type A EFB applications.
- Updating Type B EFB applications.
- Incorporating Operating System (OS) updates.

Note 1: EMC testing may need to be performed depending on the portable EFB EMC demonstration method utilized.

Note 2: Type B EFB application updates and EFB OS updates may warrant significant changes to crewmember training, procedures, and use. If any doubt exists about whether or not a program modification is considered minor or significant, the operator should consider it significant unless they determine, through contact with the FAA principal inspector (PI) and/or cabin safety inspector (CSI), that it is minor.

12.3.2 EFB Program Catalog. The EFB program catalog is a reference of the EFB hardware (make and model) and EFB applications used by crewmembers on each aircraft M/M/S and maintains configuration management of EFB program elements. An EFB program should have a process defined to keep the catalog current and readily available for PIs and CSIs. A record must be maintained for any change to the EFB program catalog; this record should be retained by the operator for 6 months. The catalog must also include:

- Current EFB OS, to include current version.
- EFB applications, to include current version.

Note: Multiple EFB applications may be bundled or integrated. Regardless, the program catalog identifies and tracks both the bundled grouping and those applications listed in Appendices A and B supporting the bundled group.

12.3.3 Software Revision. It is the responsibility of the operator to ensure the OS and EFB applications perform as intended. Other applications (i.e., non-EFB applications) hosted on a portable EFB must not adversely affect the EFB applications. To continue to qualify as Type A or B applications, unauthorized modification of, or the loading of, any new or additional software intended for operational use is not permitted unless the software can be demonstrated to perform as originally intended. Application software, OS program changes, and system configuration settings must be controlled and tested prior to use in flight. In addition to the operator's responsibilities described above, it is the responsibility of the pilot in command (PIC) to verify that any EFB depiction of an en route, terminal area, approach, airport map, or sectional is current and up-to-date. One means is to ensure each PIC becomes familiar with all available information concerning the flight, to include receipt of appropriate Notices to Air Missions (NOTAM) prior to departure and prior to arrival.

12.3.4 Database Update Process.

12.3.4.1 **Databases.** The operator should establish a method for revising EFB databases and establishing system verification with each update. The method of data revision should ensure the integrity of the data the operator loads and not negatively affect the integrity of the EFB operation. Especially when using internet and/or wireless means, procedures should exist to protect the EFB data from corruption and/or IUEI. Database revisions do not include application software or OS changes. Operators should not perform database and/or application software changes during operations (e.g., taxi, takeoff, in-flight, and landing). MET and AIS data link services, as described in AC 00-63, may receive updates for overlay information during operations (e.g., graphical weather).

12.3.4.2 **Revision Control.** Operators should also establish revision control procedures so crewmembers and others can ensure the contents of the database are current and complete. These revision control procedures may be similar to the revision control procedures used for paper or other storage media. For data subject to a revision cycle control process, it should be readily evident to the user which revision cycle is currently loaded into the EFB.

12.3.5 Data Storage and Retrieval Considerations.

12.3.5.1 **Archive Data.** If archiving data is required, operators should establish procedures to archive or retain old data. For archived data, the length of time data is kept depends on the kind of information being archived. Some

information, such as maintenance historical data, may be required to be kept for the life of the aircraft. The information (data) archived must be retrievable for the data retention period. This may include a need to convert data from older formats to ensure it is accessible by currently used tools. Operators should download maintenance discrepancy logs into a permanent record at least weekly.

12.3.5.2 Retrieval Considerations. The EFB should permit any authorized representative of the Administrator or the National Transportation Safety Board (NTSB) to retrieve, view, or print the information contained in any EFB upon receipt of a reasonable request. If the FAA or NTSB requires an operator to provide information, the operator should provide the data in a format a requesting agency can use.

12.4 Maintenance Procedures. EFB programs should include processes to ensure all EFB hardware (e.g., viewable stowage, batteries, and displays) is properly maintained for its planned life cycle.

12.5 Security Procedures.

12.5.1 Malicious Intent. The operator is responsible for ensuring security controls are in place to mitigate against the risk of IUEI to an EFB's OS architecture, its specific hosted applications, and any of the databases or data links used to enable its hosted applications (i.e., security risk assessment; refer to National Institute of Standards and Technology (NIST) Special Publication 800-53, Security and Privacy Controls for Information Systems and Organizations, as one example). The operator is also responsible for protecting the EFB from possible contamination from malware. Evidence should be provided, through analysis, testing, or a combination of both, to ensure EFB security is effective. The operator should define the processes and procedures to maintain the security level of the EFB during its entire operational life cycle.

12.5.2 Level of EFB Security. The appropriate level of EFB security depends on the criticality of the usage of the EFB application (e.g., an EFB which only holds a list of fuel prices may require less security than an EFB used for performance calculations). Beyond the level of security to ensure the EFB can properly perform as intended, the appropriate level of security ultimately depends on the capabilities of the EFB, including connections to other systems. Security impacts of connections to aircraft systems should be addressed, and special conditions may need to be addressed (refer to AC 20-173 for additional guidance).

12.5.3 Security Considerations. The following nonexhaustive list contains some examples of safety and security defense layers an operator should consider:

1. Individual system firewalls.
2. Clustering of systems with similar safety standards into domains.
3. Data encryption and authentication.

4. Virus scans.
5. Keeping the OS up-to-date.
6. Initiating air/ground connections only when required and always from the aircraft.
7. "Whitelists" for allowed internet domains.
8. "Whitelists" for allowed applications.
9. Virtual private networks (VPN).
10. Granting of access rights on a need-to-have basis.
11. Prohibiting "rooting" or "jailbreaking" of devices by employees.
12. Troubleshooting procedures should consider security threats as a potential root cause of EFB misbehavior, and responses should be developed to prevent future successful attacks, when relevant.
13. Virtualization.
14. Forensic tools and procedures.
15. Remote management applications.
16. Periodically inspecting devices for compliance with the company's EFB program.
17. Requiring passcodes for device access.

12.6 Operator Training. An EFB program must incorporate a means to train crewmembers when EFBs are introduced into an operation and when any changes to EFB hardware or EFB applications are made. EFB training should be integrated and incorporated into existing training modules during initial, transition, and recurrent training, when appropriate. Training should emphasize, but is not limited to, the following subjects and any other areas emphasized in this AC:

- The operation and controls of applicable EFB hardware, to include components and peripherals.
- The operation of the available applications and their use in the operation of the aircraft.
- The awareness of new EFB program procedures.
- The differences between a PED and an EFB.
- Limitations of EFB information, to include the relationship between the use of an EFB with traditional installed avionics and conditions (including phases of flight) when information on the EFB should be tempered or terminated.
- A description of EFB failures and applicable operational procedures, to include procedures for obtaining a backup.
- A description of security concerns and security procedures, such as operational or security procedures.

- Crew Resource Management (CRM) training in EFB procedures and use, preflight checks of the system, the use of each application on the EFB (to include display and application management), and procedures for cross-checking data entry and computed information.

12.6.1 Training of Non-Flightcrew Members. EFB training may be required for non-flightcrew members if they are using similar devices and applications and are interacting with flightcrew members using the same devices and applications. Examples are maintenance personnel, loading personnel, and dispatchers. Training should emphasize the coordinated procedures with flightcrew members.

12.6.2 Training Considerations for Installed Equipment. For EFB applications displayed on installed equipment, there may be additional training required. Additional conditions, limitations, and procedures defined in an AFM, Airplane Flight Manual Supplement (AFMS), Rotorcraft Flight Manual (RFM), Rotorcraft Flight Manual Supplement (RFMS), FSBR, OSR, or another form of documentation may be required to be included in an operator's training program. The following nonexhaustive list contains some examples of this additional documentation, which should be addressed in training:

- Descriptions of authorized special flight maneuvers, operations, and procedures the operator conducts when using an EFB.
- Differentiation between EFB-derived information and certified avionics information.
- Any special pilot/controller procedures when using EFB-based information.
- Geographical areas authorized for specific EFB operations, if applicable.
- Authorized methods to defer inoperative EFB equipment.

12.6.3 Practical Training. Training should provide an opportunity for instruction, demonstration, and practice using the actual or simulated EFB equipment and displays. Flight simulation training devices (FSTD) and other approved training devices (e.g., procedures trainers) may be used as a tool to train crewmembers on the use of EFBs. If an EFB program is authorized, EFB use and performance in the full flight simulator (FFS) should represent actual flight operations.

12.7 Minimum Equipment Lists (MEL).

12.7.1 Portable EFBs. The Master Minimum Equipment List (MMEL) and MEL are not applicable to portable EFB hardware, or EFB applications.

Note: While not covered by an operator's MEL, the loss of certain Type B EFB applications affecting operational regulatory requirements should be addressed in company procedures and establish mitigation means.

12.7.2 Installed EFBs. Installed hardware is subject to MMEL/MEL requirements. Changes made to the operator's MEL must be made in accordance with the approved MMEL. An

operator incorporating MMEL provisions into their MEL must comply with the provisions of the MEL.

12.8 Safety Management System (SMS). Part 121 operators must, under 14 CFR part 5, implement a formal process, using the SMS, for gathering feedback on the EFB program, to include any irregularities, malfunctions, or lessons learned. Use this process during design, installation, modifications, or improvements to procedures and/or training. Parts 91K and 135 operators are recommended to implement a similar process under the Safety Management System Voluntary Program (SMSVP) described in FAA Order 8900.1, Volume 17, Safety Management System.

13 EFB PROGRAM AUTHORIZATION. An operator under part 91K, 121, 125, or 135 seeking to develop an EFB program must submit an application for the applicable OpSpec/MSpec/ LOA A061. FAA inspectors will use the following guidance in addition to this AC to evaluate and process the application for an initial A061 issuance and program modifications:

- FAA Order 8900.1, Volume 4, Chapter 15, Electronic Flight Bag Program Evaluation and Authorization;
- FAA Order 8900.1, Volume 3, Chapter 1, The General Process for Approval or Acceptance of Air Operator Applications; and
- FAA Order 8900.1, Volume 3, Chapter 18, Section 3, Part A Operations Specifications—General.

13.1 Modifying an Authorized Program.

13.1.1 Minor Program Modifications. OpSpec/MSpec/LOA A061 authorizes operators to evaluate and incorporate minor modifications to their authorized EFB program without FAA review or assessment. Minor program modifications include:

- Adding/updating Type A EFB applications.
- Updating Type B EFB applications.
- Incorporating OS updates.

Note 1: Type B EFB application upgrades and EFB OS upgrades may incorporate significant changes to crewmember training, procedures, and use. If any doubt exists about whether or not a program modification is considered minor or significant, the operator should consider it significant, unless they determine, through contact with the FAA PI/CSI, that it is minor.

Note 2: EMC testing may need to be performed, depending on the portable EFB EMC demonstration method utilized.

13.1.2 Significant Program Modifications. Modifications determined to be greater than minor program modifications require formal FAA review and evaluation before they can be authorized for incorporation into an EFB program. Unlike an evaluation of an initial EFB

program application, applications for modifications to an authorized EFB program can be tailored at the discretion of the FAA inspector.

13.1.3 Non-EFB Applications and Other Proposals Not Addressed in This AC. Proposed EFB program modifications for the addition of applications not listed in Appendix A or B, or means of compliance not addressed in this AC, must be routed by the responsible Flight Standards office to the Flight Technologies and Procedures Division for further evaluation, as specified in paragraph 8 of this AC.

13.2 Authorization Process for EFB Applications as Approved Software. Software with an airworthiness approval performing an EFB application may be utilized to support operational requirements without further PI evaluation of the software. OpSpec/MSpec/LOA A061 is issued when all applicable EFB program requirements are considered satisfied.

13.3 Operator Coordination Responsibilities. Use and performance of portable EFB hardware and EFB applications is the responsibility of the operator. An operator should coordinate closely with the responsible Flight Standards office. It is the operator's responsibility to consider all applicable sections of this AC when designing their EFB program.

14 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.

David H. Boulter
Acting Associate Administrator for Aviation Safety

APPENDIX A. TYPE A ELECTRONIC FLIGHT BAG (EFB) APPLICATIONS

A.1 Type A EFB Applications.

1. Airport diversion policy guidance, including a list of special designated airports and/or approved airports with Emergency Medical Service (EMS) support facilities.
2. Flight management system (FMS)/Flight Management Guidance System (FMGS) problem report forms.
3. Aircraft parts manuals.
4. Airlines for America (A4A) 100-format maintenance discrepancy write-up codes.
5. Required Very High Frequency Omnidirectional Range (VOR) check records.
6. Minimum equipment lists (MEL).
7. Configuration Deviation Lists (CDL).
8. Nonessential Equipment and Furnishings (NEF) lists.
9. Federal, state, and airport-specific rules and regulations.
10. Chart Supplements (formerly the Airport/Facility Directory (A/FD)) data (e.g., fuel availability, land-and-hold-short operations (LAHSO) distances for specific runway combinations).
11. Noise abatement procedures for arriving and departing aircraft.
12. International Operations Manuals, including regional supplementary information and International Civil Aviation Organization (ICAO) differences.
13. Aeronautical Information Publications (AIP).
14. Aeronautical Information Manual (AIM).
15. Pilot flight and duty-time logs.
16. Crewmember-required rest logs.
17. Flightcrew member qualification logs (such as aircraft qualifications, Class II flightcrew member qualifications, Category (CAT) III qualifications, high minimums logs, night currency logs, pilot-in-command (PIC) qualifications for special areas, routes, and airports for Title 14 of the Code of Federal Regulations (14 CFR) part 121 certificate holders (CH) and special airports qualifications).
18. Flightcrew member qualifications recordkeeping, including aircraft qualifications, landing currency, flight time and duty-time, PIC currency requirements, etc.
19. Captain's report (i.e., captain's incident reporting form).
20. Crewmember survey forms (various).
21. EMS reference library (for use during medical emergencies).
22. Trip scheduling and bid lists.
23. Aircraft captain's logs.

24. Antiterrorism profile data.
25. Hazardous materials (HAZMAT)/oxidizer lookup tables.
26. Customs declaration and United States Department of Agriculture (USDA) agriculture inspection/clearance form.
27. Special reporting forms, such as near midair collision (NMAC) reports, National Aeronautics and Space Administration's (NASA) Aviation Safety Reporting System (ASRS), bird and wildlife encounters, owner-initiated Service Difficulty Reports (SDR), etc.
28. Incidents of interference to aircraft electronic equipment from devices carried on board aircraft.
29. Current fuel prices at various airports.
30. Computer-based training modules, check pilot, and flight instructor records.
31. Airline Policy and Procedures Manuals (PPM).
32. Title 14 CFR.
33. Lookup and completion of various reporting forms (e.g., company-specific forms, NASA's ASRS reports, NMAC reports, and wildlife strike and hazard reports).
34. Passenger information requests—some are directed to the gate or to the agent meeting the flight (e.g., special meal requests, wheelchair requirements, unaccompanied minors, gate information for connecting flights, and flights being held for connecting passengers).
35. Service Bulletins (SB)/published Airworthiness Directives (AD), etc.

APPENDIX B. TYPE B ELECTRONIC FLIGHT BAG (EFB) APPLICATIONS

B.1 Type B EFB Applications.

1. Airplane Flight Manuals (AFM) (or Rotorcraft Flight Manuals (RFM)) and Airplane Flight Manual Supplement (AFMS) (or Rotorcraft Flight Manual Supplement (RFMS)).
2. Flight attendant (F/A) manuals.
3. Flight Operations Manuals (FOM).
4. For smaller aircraft, pilot's operating handbooks (POH), including POH section IX supplements.
5. Company General Operations Manuals (GOM).
6. Maintenance manuals.
7. Aircraft maintenance reporting manuals.
8. Company standard operating procedures (SOP).
9. Aircraft operating and information manuals (performance information, Weight and Balance (W&B), systems, limitations, etc.).
10. Aircraft performance data manuals (fixed non-interactive material).
11. Airport performance restrictions manual (e.g., a reference for takeoff and landing performance calculations).
12. W&B manual, if a separate manual (fixed non-interactive material).
13. W&B calculations.
14. Takeoff, en route, approach and landing, missed approach, go-around, etc., performance calculations. Data derived from algorithmic data or performance calculations based on software algorithms.
15. Other aircraft performance data manuals, including specialized performance data for use in conjunction with advanced wake vortex modeling techniques, and land-and-hold-short operations (LAHSO) predictions, etc. (fixed, non-interactive material for planning purposes).
16. Operations specifications (OpSpecs), management specifications (MSpecs), or Letters of Authorization (LOA).
17. Power settings for reduced thrust settings.
18. Runway limiting performance calculations.
19. Cost index modeling/flight optimization planning software.
20. Master flight plan/updating.
21. Interactive plotting for oceanic and remote navigation.

Note: A depiction of EFB own-ship may be included on this EFB application if the aircraft has a navigation moving map display (navigation display) providing concurrent display of the active flight plan, aircraft position, and aircraft trajectory (e.g., heading if a heading is selected). The EFB application may display additional, unique data elements, such as other oceanic routes, but must have sufficient common data to allow the crewmember to resolve discrepancies to qualify as a Type B EFB application.

22. Maintenance discrepancy signoff logs (maintenance discrepancy logs need to be downloaded into a permanent record at least weekly).
23. Cabin maintenance discrepancy reporting forms/location codes (maintenance discrepancy logs need to be downloaded into a permanent record at least weekly).
24. Electronic aeronautical charts (e.g., arrival, departure, en route, area, approach, and airport charts) which may be static/pre-composed (raster), or dynamic/data-driven (vector).

    Note: A depiction of EFB own-ship may be included on this EFB application if the aircraft has a navigation moving map display (navigation display) providing concurrent display of the active flight plan, aircraft position, and aircraft trajectory (e.g., heading if a heading is selected). The EFB application may display additional, unique data elements, such as airspace boundaries, but must have sufficient common data to allow the crewmember to resolve discrepancies to qualify as a Type B EFB application.

25. Electronic checklists (ECL), including normal, abnormal, and emergency. EFB ECLs cannot be interactive with other aircraft systems.

    Note: A current paper backup checklist may be required to be carried on board the aircraft and be readily accessible to the crew.

26. Applications making use of the internet and/or other Aeronautical/Airline Operational Control (AOC) or company maintenance-specific data links to collect, process, and then disseminate data for uses such as spare parts and budget management, spares/inventory control, and unscheduled maintenance scheduling, etc. (maintenance discrepancy logs need to be downloaded into a permanent record at least weekly).
27. Weather and aeronautical information.

    Note: A depiction of EFB own-ship may be included on this EFB application if the aircraft has a weather radar display providing concurrent display of proximate weather hazards. The EFB application may display additional, unique data elements, such as turbulence or data outside the range of the weather radar, but must have sufficient common data to allow the crewmember to resolve discrepancies to qualify as a Type B EFB application.

28. Aircraft cabin and exterior video surveillance displays.
29. Aircraft's Category (CAT) II/CAT III landing records.

30. Aircraft flight log and servicing records.
31. Autopilot approach and autoland records.
32. Cockpit observer briefing cards.
33. Oceanic navigation progress logs.
34. Approved electronic signature using Public Key Infrastructure (PKI) or private key technology.
35. Cabin maintenance write-ups (maintenance discrepancy logs need to be downloaded into a permanent record at least weekly).
36. Maintenance personnel signoff of discrepancy form (maintenance discrepancy logs need to be downloaded into a permanent record at least weekly).
37. Aircraft Maintenance Manuals (AMM).
38. Notices to Air Missions (NOTAM).
39. Required dispatch or flight release documentation.
40. Icing holdover time tables.
41. International Civil Aviation Organization (ICAO) Doc 9481, Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods.
42. Audio transcription (intended for use only as a supplemental reference for voice communications).
43. Basic Airborne and Surface Traffic Information.

    Note: A depiction of EFB own-ship may be included on this EFB application if the aircraft has an installed Traffic Display System (TDS) (i.e., at a minimum, either an Automatic Dependent Surveillance-Broadcast (ADS-B) In system with a basic airborne application display or Traffic Alert and Collision Avoidance System (TCAS) II) providing concurrent display of the active traffic, aircraft position, and aircraft trajectory. The EFB application may display additional, unique data elements, such as data outside the reliable surveillance range of TCAS II, but must have sufficient common data to allow the crewmember to resolve discrepancies to qualify as a Type B EFB application.

44. Supplemental oxygen supply calculations for supply duration and/or supply range which are specific to the aircraft being operated.

    Note 1: This EFB function is intended to support strategic decision making only. Pilots should rely on the aircraft's oxygen pressure gauge (analog or digital) for tactical decision making.

    Note 2: A depiction of EFB own-ship may be included on this EFB application if the aircraft has a navigation moving map display (navigation display) providing concurrent display of the active flight plan, aircraft

position, and aircraft trajectory (e.g., heading if a heading is selected). The EFB application may display additional, unique data elements, such as other oceanic routes, but must have sufficient common data to allow the flightcrew member to resolve discrepancies.

45. Voice and/or video communication with emergency medical assistance services.

APPENDIX C. ADDITIONAL RESOURCES

C.1 Related Reading Materials.

C.1.1 Advisory Circulars (AC) (current editions).

1. AC 00-63, Use of Flight Deck Displays of Digital Weather and Aeronautical Information.
2. AC 20-115, Airborne Software Development Assurance Using EUROCAE ED-12() and RTCA DO-178().
3. AC 20-140, Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services (ATS).
4. AC 20-164, Designing and Demonstrating Aircraft Tolerance to Portable Electronic Devices.
5. AC 20-173, Installation of Electronic Flight Bag Components.
6. AC 20-175, Controls for Flight Deck Systems.
7. AC 20-184, Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft.
8. AC 21-40, Guide for Obtaining a Supplemental Type Certificate.
9. AC 23.1309-1, System Safety Analysis and Assessment for Part 23 Airplanes.
10. AC 23.1311-1, Installation of Electronic Display in Part 23 Airplanes.
11. AC 25-11, Electronic Flight Displays.
12. AC 25-16, Electrical Fault and Fire Prevention and Protection.
13. AC 25.773-1, Pilot Compartment View Design Considerations.
14. AC 25.1523-1, Minimum Flightcrew.
15. AC 25.1581-1, Airplane Flight Manual.
16. AC 27-1, Certification of Normal Category Rotorcraft, Miscellaneous Guidance (MG) 16, Certification Guidance for Rotorcraft Night Vision Imaging System (NVIS) Aircraft Lighting Systems.
17. AC 29-2, Certification of Transport Category Rotorcraft, MG 16, Certification Guidance for Rotorcraft Night Vision Imaging System (NVIS) Aircraft Lighting Systems.
18. AC 91-78, Use of Class 1 or Class 2 Electronic Flight Bag (EFB).
19. AC 91.21-1, Use of Portable Electronic Devices Aboard Aircraft.
20. AC 120-64, Operational Use and Modification of Electronic Checklists.
21. AC 120-71, Standard Operating Procedures and Pilot Monitoring Duties for Flight Deck Crewmembers.

22. AC 120-74, Parts 91, 121, 125, and 135 Flightcrew Procedures During Taxi Operations.
23. AC 120-80, In-Flight Fires.

C.1.2 FAA Orders, Policy Statements (PS), and Technical Standard Orders (TSO) (current editions).

1. FAA Order 8110.4, Type Certification.
2. FAA Order 8150.1, Technical Standard Order Program.
3. FAA Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS).
4. FAA Order 8900.1, Flight Standards Information Management System.
5. PS-ANM100-01-03A, Factors to Consider When Reviewing an Applicant's Proposed Human Factors Methods of Compliance for Flight Deck Certification.
6. PS-ANM111-1999-99-2, Guidance for Reviewing Certification Plans to Address Human Factors for Certification of Transport Airplane Flight Decks.
7. TSO-C113, Airborne Multipurpose Electronic Displays.
8. TSO-C165, Electronic Map Display Equipment for Graphical Depiction of Aircraft Position (Own-Ship).

C.1.3 Industry Documents (current editions).

1. RTCA DO-160, Environmental Conditions and Test Procedures for Airborne Equipment.
2. RTCA DO-178, Software Considerations in Airborne Systems and Equipment Certification.
3. RTCA DO-199, Potential Interference to Aircraft Electronic Equipment from Devices Carried Aboard (Vols I and II).
4. RTCA DO-200, Standards for Processing Aeronautical Data.
5. RTCA DO-201, User Requirements for Navigation Data.
6. RTCA DO-208, Minimum Operational Performance Standards for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS).
7. RTCA DO-233, Portable Electronic Devices Carried Onboard Aircraft.
8. RTCA DO-242, Minimum Aviation System Performance Standards for Automatic Dependent Surveillance-Broadcast (ADS-B).
9. RTCA DO-249, Development and Implementation Planning Guide for Automatic Dependent Surveillance-Broadcast (ADS-B) Applications.
10. RTCA DO-254, Design Assurance Guidance for Airborne Electronic Hardware.
11. RTCA DO-255, Requirements Specification for Avionics Computer Resource (ACR).

12. RTCA DO-257, Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps.
13. RTCA DO-260, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B).
14. RTCA DO-264, Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications.
15. RTCA DO-267, Minimum Aviation System Performance Standards (MASPS) for Flight Information Service-Broadcast (FIS-B) Data Link.
16. RTCA DO-272, User Requirements for Aerodrome Mapping Information.
17. RTCA DO-275, Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment.
18. RTCA DO-276, User Requirements for Terrain and Obstacle Data.
19. RTCA DO-282, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B).
20. RTCA DO-294, Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDS) on Aircraft.
21. RTCA DO-307, Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance.
22. RTCA DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Batteries and Battery Systems.
23. RTCA DO-363, Guidance for the Development of Portable Electronic Devices (PED) Tolerance for Civil Aircraft.
24. ARINC 424, Navigation System Database.
25. ARINC 653P( ), Avionics Application Software Standard Interface.
26. ARINC 653P1, Avionics Application Software Standard Interface Part 1 – Required Services.
27. ARINC 653P2, Avionics Application Software Standard Interface Part 2 – Extended Services.
28. ARINC 653P3, Avionics Application Software Standard Interface Part 3 – Conformity Test Specifications for ARINC 653 Extended Services.
29. ARINC 660, CNS/ATM Avionics Architectures Supporting NextGen/SESAR Concepts.
30. ARINC 661, Cockpit Display System Interfaces to User Systems.
31. ARINC 828, Electronic Flight Bag (EFB) Standard Interface.
32. ARINC 834, Aircraft Data Interface Function (ADIF).

33. ARINC 840, Electronic Flight Bag (EFB) Application Control Interface (ACI) Standard.
34. Aerospace Recommended Practice (ARP) 4754, Guidelines for Development of Civil Aircraft and Systems.
35. ARP4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.
36. ARP5289, Electronic Aeronautical Symbols.
37. ARP5621, Electronic Display of Aeronautical Information (Charts).
38. United Nations (UN) Transportation Regulations, Manual of Tests and Criteria (ST/SG/AC.10/11).
39. UN ST/SG/AC.10/11/Rev.5/Amend.2, Amendments to the Fifth Revised Edition of the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria.
40. National Institute of Standards and Technology (NIST) Special Publication 800-30, Guide for Conducting Risk Assessments.
41. Institute of Electrical and Electronic Engineers (IEEE) 1725-2021, IEEE Standard for Rechargeable Batteries for Mobile Phones.

C.1.4 Additional Guidance.

1. DOT/FAA/TC-16/56, Human Factors Considerations in the Design and Evaluation of Flight Deck Displays and Controls, Version 2. Yeh, M.; Swider, C.; Donovan, C.; and Jo, Y.J., December 2016.
2. The FAA and Industry Guide to Product Certification, Third Edition, May 2017. Available at https://www.faa.gov/aircraft/air_cert/design_approvals/media/CPI_guide_II.pdf.
3. DOT/FAA/RD-93/5, Human Factors for Flight Deck Certification Personnel, July 1993. Available at https://rosap.ntl.bts.gov/view/dot/8679.
4. A Report from the Portable Electronic Devices Aviation Rulemaking Committee to the Federal Aviation Administration: Recommendations on Expanding the Use of Portable Electronic Devices During Flight, September 30, 2013. Available within the file at https://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/document/information/documentID/1062/.
5. International Civil Aviation Organization (ICAO) Doc 10020, Manual on Electronic Flight Bags (EFBs).
6. ICAO Annex 6, Operation of Aircraft, Part I, International Commercial Air Transport—Aeroplanes.
7. ICAO Annex 6, Operation of Aircraft, Part II, International General Aviation—Aeroplanes.
8. ICAO Annex 6, Operation of Aircraft, Part III, International Operations—Helicopters.