U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Guidelines for the Certification, Airworthiness, and Operational Use of Electronic Flight Bags

Date: 5-9-14 **AC No:** 120-76C

Initiated by: AFS-400 **Change:**

1. PURPOSE. This joint Flight Standards Service (AFS) and Aircraft Certification Service (AIR) advisory circular (AC) contains guidance on the operational use of Electronic Flight Bags (EFBs). It is intended for all operators conducting flight operations under Title 14 of the Code of Federal Regulations (14 CFR) part 121, 125, 135, or 91 subpart F (part 91F) and part 91 subpart K (part 91K) who want to replace required paper information or utilize other select functions of an EFB. 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. Part 91 operators can find additional EFB information in the current edition of AC 91-78, Use of Class 1 or Class 2 Electronic Flight Bag (EFB). For guidance on the installation of EFB components, refer to the current edition of AC 20-173, Installation of Electronic Flight Bag Components.

2. EFFECTIVE DATE. The effective date of this AC is May 9, 2014.

3. CANCELLATION. This AC cancels AC 120-76B, Guidelines for the Certification, Airworthiness, and Operational Use of Electronic Flight Bags, dated June 1, 2012.

4. RELATED 14 CFR PARTS. Parts 21, 23, 25, 27, 29, 43, 91F, 91K, 121, 125, and 135.

5. DEFINITIONS. The following definitions are specific to this AC and may differ from those definitions contained in other published references.

a. Administrative Control Process. Operator-administered procedure to record and log the removal or addition of installed EFB components.

b. Approved Software. Software approved by the FAA using the current edition of RTCA/DO-178, Software Considerations in Airborne Systems and Equipment Certification, compliance, or other acceptable means. For guidance refer to AC 20-173.

c. Class 1 Electronic Flight Bag (EFB) Hardware. Portable commercial off-the-shelf (COTS)-based computers, considered to be portable electronic devices (PED) with no FAA design, production, or installation approval for the device and its internal components. Class 1 EFBs are not mounted to the aircraft, connected to aircraft systems for data, or connected to a dedicated aircraft power supply. Class 1 EFBs can be temporarily connected to an existing aircraft power supply for battery recharging. Class 1 EFBs that have Type B applications for aeronautical charts, approach charts, or an electronic checklist (ECL) must be appropriately

secured and viewable during critical phases of flight and must not interfere with flight control movement.

> **NOTE: Portable Class 1 EFB components are not considered to be part of aircraft type design (i.e., not in the aircraft type certificate (TC) or Supplemental Type Certificate (STC)).**

d. Class 2 EFB Hardware. Portable COTS-based computers, considered to be PEDs with no FAA design, production, or installation approval for the device and its internal components. Class 2 EFBs are typically mounted. They must be capable of being easily removed from or attached to their mounts by flightcrew personnel. Class 2 EFBs can be temporarily connected to an existing aircraft power supply for battery recharging. They may connect to aircraft power, data ports (wired or wireless), or installed antennas, provided those connections are installed in accordance with AC 20-173. (Portable Class 2 EFB components are not considered to be part of aircraft type design; i.e., not in the aircraft TC or STC.)

e. Class 3 EFB Hardware. EFBs installed in accordance with applicable airworthiness regulations. Refer to AC 20-173 for guidance on the installation of EFB components.

f. Critical Phases of Flight. Includes all ground operations involving taxi, takeoff, and landing, and all other flight operations conducted below 10,000 feet, except cruise flight.

> **NOTE: For the purpose of this AC, we've adopted the critical phases of flight definition in part 121, § 121.542.**

g. EFB. An electronic display system intended primarily for flight deck or cabin crew member use that includes the hardware and software necessary to support an intended function. EFB devices can display a variety of aviation data or perform basic calculations (e.g., performance data, fuel calculations, etc.). In the past, some of these functions were traditionally accomplished using paper references or were based on data provided to the flightcrew by an airline's flight dispatch function. The scope of the EFB functionality may include various other hosted databases and applications. Physical EFB displays may use various technologies, formats, and forms of communication. An EFB must be able to host and actively display Type A and/or Type B software applications.

h. Hosted Application. Software running on an EFB that is not installed or considered part of aircraft type design.

i. Interactive Information. Information presented on the EFB that, via software applications, can be selected and rendered in a number of dynamic ways. This includes variables in the information presented based on data-oriented software algorithms, concepts of decluttering, and selectable composition as opposed to precomposed information.

j. Mounted. Any portable device that is attached to a permanently installed mounting device.

k. Mounting Device. These include arm-mounted, cradle, clips, docking stations, etc.

l. PED. Section 91.21; § 121.306; part 125, § 125.204; and part 135, § 135.144 refer to PEDs and place restrictions on the in-flight use of PEDs. There are two types of PEDs and two methods of compliance with these regulations.

(1) The non-EFB PED method of compliance with PED regulations is in the current edition of AC 91.21-1, Use of Portable Electronic Devices Aboard Aircraft. Use of these PEDs is prohibited in instrument flight rules (IFR) flight operations, except in cruise flight.

(2) The EFB PED method of compliance with PED regulations is in FAA Order 8900.1, Flight Standards Information Management System (FSIMS), Volume 4, Chapter 15, Section 1, Electronic Flight Bag Operational Authorization Process, and this AC.

> **NOTE: For a PED to be considered an EFB, the PED must host and actively display Type A, B, and/or C software applications as applicable, and requires the issuance of Operations Specifications (OpSpec) paragraph A061 "Use of Electronic Flight Bag."**

m. Precomposed Information. Information previously composed into a static, composed state (non-interactive). The composed displays have consistent, defined, and verifiable content, and formats that are fixed in composition.

n. Stowed. A portable device that is placed in a secure stowage location but is not available for use or view by the pilot in that location.

o. Transmitting Portable Electronic Devices (T-PED). PEDs that have intended radio frequency (RF) transmission capabilities.

p. Type A Software Applications. Type A software applications are those paper replacement applications primarily intended for use during flight planning, on the ground, or during noncritical phases of flight having a failure condition classification considered to be a minor hazard or less. Appendix 1 lists examples of Type A software applications.

q. Type B Software Applications. Type B software applications are those paper replacement applications that provide the aeronautical information required to be accessible for each flight at the pilot station and are primarily intended for use during flight planning and all phases of flight. Type B applications include miscellaneous, nonrequired applications (e.g., aircraft cabin and exterior surveillance video displays, maintenance applications) having a failure condition classification considered to be a minor hazard or less. Appendix 2 lists examples of Type B software applications.

r. Type C Software Applications. Type C software applications are approved by the FAA using RTCA/DO-178 or another acceptable means. These are "non-EFB" software applications found in avionics and include intended functions for communications, navigation, and surveillance that require FAA design, production, and installation approval. Type C applications are approved software for surface and airborne functions with a failure condition classification considered to be a major hazard or higher.

s. Viewable Stowage. A portable device that is secured in an existing provision with the intended function to hold charts or acceptable temporarily secured portable device viewable to the pilot (e.g., kneeboards, suction cups, etc.).

6. RELATED READING MATERIALS. See Appendix 3 for a list of references.

7. BACKGROUND. Class 1 and Class 2 EFBs are both considered PEDs. The use of any PED in an aircraft is subject to compliance with PED regulations (§§ 91.21, 121.306, 125.204, and 135.144). The PED regulations' applicability addresses certificated operators and IFR aircraft. Aircraft operated under part 91, except for parts 91F and 91K, require no EFB authorization or compliance with this AC, provided the EFB does not replace any equipment or operating information required by the regulations. For all aircraft, PED regulatory compliance is required. PED regulatory methods for compliance are addressed in this AC and AC 91.21-1. There are two separate methods of compliance respective to non-EFB PEDs and EFB PEDs. Non-EFB PED compliance is in accordance with AC 91.21-1 and restricts the use of PEDs in flight operations, except when safely in cruise and/or above 10,000 feet above ground level (AGL). All PEDs are subject to these restrictions unless they are authorized EFBs. To be an authorized EFB, the PED must host one or more of the authorized EFB functions listed in Appendices 1 and 2 and meet the additional evaluation criteria in paragraphs 11 and 12.

8. APPLICABILITY. One of the major motivators for using an EFB is to reduce or eliminate the need for paper and other reference materials in the cockpit. This AC describes the EFB functions, features, and selected hosted applications, and applies to the authorization for use of both portable and installed EFBs.

9. SCOPE. The primary intent of the guidance material described in this AC is to assist operators and flightcrews in transitioning from the paper products in a traditional flight bag to an electronic format. Use this AC in combination with other material contained in current communications, navigation, and surveillance ACs or other FAA-approved guidance material. The intent of this AC is to provide specific guidance material for certain EFB applications and to establish guidance for operational use of EFBs by flight deck crewmembers and other crewmembers in the cabin. The intention of this AC is not to supersede existing operational guidance material. Do not use this AC to add own-ship position in-flight on Class 1 and Class 2 EFBs. If you use the means described in this AC to display own-ship position on the airport surface on an EFB, you must follow it entirely.

10. DISPLAY OF OWN-SHIP POSITION. The display of an own-ship symbol limited to the airport surface is identified by this AC as a Type B software application and limited to functions having a failure condition classification considered to be a minor hazard or less, and only for use at speeds of less than 80 knots (kts). Type B software applications using own-ship may be considered only an aid to situational awareness; no use in operations other than an aid to situational awareness will be authorized (i.e., not appropriate for: surface navigation, surface alerting, time-based operations, guidance, maneuvering, and control functions, etc.). Display of own-ship position on the airport surface as a Type B application is intended to help flightcrews orient themselves on an airport chart/map, and to improve pilot positional awareness during taxi takeoff, and upon landing. Type B software applications using display of own-ship position on the airport surface are not sufficient to be used as the basis for operational guidance,

maneuvering, and control, and assume compliance with the operational guidelines in AC 120-74, Parts 91, 121, 125, and 135 Flightcrew Procedures during Taxi Operations. Airborne and surface functions with a failure condition classification of major hazard or higher, which includes depiction of own-ship position in-flight, require approved software (refer to AC 20-173).

11. EFB CLASSIFICATIONS FOR AIRWORTHINESS CERTIFICATION AND AUTHORIZATION FOR USE. All information contained in the EFB intended for operational use must be current and up-to-date. Refer to Appendices 1 and 2 for a list of EFB application examples. In addition to the applications listed in Appendices 1 and 2, the Aircraft Evaluation Group (AEG) may have a record of Flight Standardization Board (FSB) reports or Operational Suitability Reports (OSR) on file that contain hardware and software applications/functions that have been evaluated. Airworthiness regulations apply to installed EFB components. They do not apply to portable EFB components other than for specifications associated with the installed components (i.e., mounting (size and weight), power (maximum electrical load, voltage, and current frequency), and data connectivity (input/output (I/O) data specifications and security)). For guidance on the installation of EFB components, refer to AC 20-173. The following guidance is used to determine EFB classification as well as roles and responsibilities.

a. Class 1 EFB Hardware. These EFBs are portable COTS devices that are not mounted to the aircraft. Class 1 EFBs do not have dedicated power connectivity and have no data connectivity with installed aircraft systems. Class 1 EFBs that have Type B applications for aeronautical charts, approach charts, or ECLs, must be appropriately secured and viewable during critical phases of flight and must not interfere with flight control movement or pilot egress. An EFB that is temporarily secured may still be considered a Class 1 EFB if it is not mounted to the aircraft. The operator must document EFB non-interference to show operational suitability and compliance with the guidance in subparagraph 11.f.(2) or 11.f.(3) of this AC when intended for use in all phases of flight. For Class 1 devices with Type A applications that are not required in critical phases of flight, the operator must document EFB non-interference to show operational suitability and compliance with the guidance in AC 91.21-1 and this AC.

b. Class 2 EFB Hardware. These EFBs are typically mounted to the aircraft by a mounting device and may be connected to a data source, a hardwired power source, and an installed antenna, provided those connections are installed in accordance with applicable airworthiness regulations. In order to be considered portable, the EFB must be removable from the flight deck without the use of tools, and a pilot crewmember must be able to perform the task. Portable EFBs must be located on the flight deck and controlled by the flightcrew or, as applicable, in the cabin and controlled by the cabin crew during all flight operations. Although attached to the aircraft via a mounting device, Class 2 EFB hardware must be accessible to the flightcrew and must be removable without the use of tools. The components of the Class 2 EFB include all the hardware and software needed to support EFB intended functions. A Class 2 EFB may consist of modular components (e.g., computer processing unit, display, controls). Any EFB hardware not accessible to the flightcrew on the flight deck and/or not portable must be installed in accordance with the applicable airworthiness regulations. For guidance on the installation of EFB components, refer to AC 20-173.

> **NOTE: Portable EFBs are limited to hosting Type A and Type B software applications with intended functions limited to a minor failure effect**

classification. However, Type B software applications using a depiction of an own-ship symbol are limited to airport surface operations only and to speeds of less than 80 kts ground speed.

(1) The operator must document PED non-interference regulatory compliance as explained in AC 91.21-1 and subparagraph 1l.f.(2) in this AC as part of the EFB authorization process if Type A,B, or C software applications will be used during a critical phase of flight.

(2) FAA airworthiness approval is limited to the aircraft connectivity provisions (i.e., mounting device (e.g., arm-mounted, cradle, yoke-clip), data connectivity, installed antennas, and power connection) installed in accordance with applicable airworthiness regulations.

- EFB mounting requires installation in accordance with the applicable airworthiness regulations for the integrity of mounting, location, non-impeded egress, accessibility to instruments and controls, physical interference, etc.
- EFB data connections require installation in accordance with the applicable airworthiness regulations to ensure non-interference and isolation from aircraft systems during transmission and reception. The EFB may receive information from any aircraft system, as well as transmit or receive information for Airline Administrative Control (AAC)/Airline Operational Communications (AOC) purposes. Connectivity may be wired or wireless (refer to AC 20-173).
- Class 2 EFB hardware, internal components, and software do not require FAA airworthiness approval.

(3) Class 2 EFB mounting devices, installed antennas, power connections, and data connectivity provisions installed in accordance with applicable airworthiness regulations may require Airplane Flight Manual (AFM) or Airplane Flight Manual Supplement (AFMS) revisions.

(4) Removal/attachment of a Class 2 EFB from the aircraft may be completed by the flightcrew without maintenance tasks through an administrative control process if the EFB is assigned to the aircraft (e.g., logbook entry) or the EFB may be assigned to the pilot without administrative control.

(5) Operators must determine non-interference and operational suitability with existing aircraft systems for all flight phases and ensure that the system performs the intended function.

c. Class 3 EFB Hardware. EFBs installed in accordance with the applicable airworthiness regulations. For guidance on the installation of EFB components, refer to AC 20-173.

d. Type A EFB Software Application. Appendix 1 lists examples of EFB-hosted software applications. Type A software applications include precomposed, fixed presentations of data currently presented in paper format. Type A applications are typically intended to be used on the ground or during noncritical phases of flight having a failure condition classification considered to be a minor hazard or less. The operator must possess evidence demonstrating that operational requirements are met when using the applications listed in Appendix 1.

(1) Type A application software does not require compliance with RTCA/DO-178.

(2) Type A application software may reside on any EFB hardware classification (Class 1, 2, or 3).

(3) The operator can use the application after successful completion of the user/operator evaluation (including flightcrew training, checking, and currency requirements).

(4) Type A application software for Weight and Balance (W&B) are applications that present existing information found in the applicable AFM, pilot's operating handbook (POH), or W&B manual. These Type A applications are exact electronic replications of the printed document they replace (e.g., PDF files).

(5) Type A application software for aircraft performance are applications that present existing information found in the applicable AFM or POH. These Type A applications are electronic replications of the printed document they replace (e.g., PDF files).

(6) Operators must determine the usage of hardware and/or software architectural features, people, procedures, and/or equipment to eliminate, reduce, or control risks associated with an identified failure in a system.

(7) The operator should provide evidence demonstrating that the EFB operating system and hosted application software can perform the intended function and do not provide false or hazardously misleading information. This evidence includes demonstration that software revisions will not corrupt the data integrity of the original software performance.

e. Type B EFB Software Applications. Appendix 2 lists examples of EFB-hosted software applications. Type B applications include dynamic, interactive applications that can manipulate data and presentation for operationally required and other paper reference materials. Type B applications are applications that are intended for use during critical phases of flight having a failure condition classification considered to be a minor hazard or less. The operator must provide evidence demonstrating that the operational requirements are met when using the applications listed in Appendix 2.

(1) Type B application software does not require compliance with RTCA/DO-178.

(2) Type B application software may reside on any EFB hardware classification (Class 1, 2, or 3).

(3) The operator can use the application after successful completion of the user/operator evaluation (including flightcrew training, checking, and currency requirements) or in accordance with FSB reports.

(4) Type B applications are used to display precomposed or interactive information such as navigation or approach charts, as well as depiction of an own-ship symbol limited to airport surface operations only at speeds of less than 80 kts gorund speed. Required flight information should be readily available for display for each applicable phase of flight. Depiction of own-ship position limited to airport surface operations at speeds of less than 80 kts ground speed can be

authorized if the operator properly evaluates them (see FAA Order 8900.1, Volume 4, Chapter 15, Electronic Flight Bag Authorization for Use, for criteria).

NOTE: Class 1 or Class 2 EFBs must not display own-ship position while in flight.

(a) Operators must determine the usage of hardware and/or software architectural features, people, procedures, and/or equipment to eliminate, reduce, or control risks associated with an identified failure in a system.

(b) The operator should provide evidence demonstrating that the EFB operating system and hosted application software can perform the intended function and do not provide false or hazardously misleading information. This evidence includes a demonstration that software revisions do not corrupt the data integrity or intended function of the original installed software configuration.

(c) Data link EFB functions may display approved sources of weather for strategic/flight planning purposes. Weather and aeronautical information such as data-linked meteorology information (MET) and Aeronautical Information Service (AIS) products are for advisory use only. These products enhance situational awareness, but lack the service delivery reliability and updating necessary for tactical maneuvering/use. Do not use data-linked MET and AIS products as a sole source 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). Current data-linked MET and AIS products may support strategic decisionmaking (e.g., route selection to avoid a weather hazard area in its entirety). For more information on this subject, refer to the current editions of AC 00-45, Aviation Weather Services, and AC 00-63, Use of Cockpit Displays of Digital Weather and Operational Information.

(d) 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 can only be used for strategic/flight planning purposes. Do not use data link graphical weather information for tactical decisions during critical phases of flight, because data quality is uncontrolled for aviation use. Do not use data link graphical weather data as a substitute for airborne weather radar or thunderstorm detection equipment.

(e) Type B applications for W&B are software applications based on the existing information found in the FAA-approved AFM, 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. Type B W&B applications adhere to existing approved data and must be validated for accuracy in the entire aircraft operating envelope. Type B W&B applications may use algorithms to calculate W&B results or may use basic mathematics combined with data spreadsheets to determine W&B results. Algorithms may have the ability to interpolate data but must not extrapolate, and therefore must be tested and proven accurate by the manufacturer or operator to represent the AFM- or Rotorcraft Flight Manual (RFM)-approved data. Type B W&B applications are produced for a specific aircraft and based on AFM-approved data.

(f) Type B applications for performance are software applications based on existing published data as 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 determination of applicable aircraft performance data. Type B performance applications must adhere to this published data and must 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 may use data spreadsheets to determine results. Algorithms may have the ability to interpolate but must not extrapolate beyond the information contained in the current published data. These algorithms have to 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 AFM-approved 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 approved AFM data.

(g) Type B W&B and/or performance software applications require validation 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 that calculate 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 AFM-approved data. The Type B application must always be demonstrated to be traceable to the paper AFM-approved data. These Type B applications must not allow entry input or output of data outside the AFM data envelope(s). Sufficient data points based on application architecture must be tested and documented to show that the applications accurately adhere to and are limited to the AFM-approved 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 paper AFM data. Type B W&B and/or performance applications must meet the approval criteria listed in FAA Order 8900.1, Volume 4, Chapter 3, Section 3, Approval of Performance Data Sections of CFMs.

(h) Develop operational procedures for use in aircraft. These procedures should define the roles that the flightcrew and dispatch/flight following have in creating and reviewing performance calculations. Operations specifications (OpSpecs) must be issued as appropriate.

(i) Type B applications require a validation period to ensure the reliability of the EFB functions prior to the removal of the applicable paper documents. Operational procedures must be established to verify the accuracy of inputs and outputs of Type B application software. Validation is a necessary part of risk mitigation to ensure the effective function and reliability of EFB hardware, software, and procedures. A validation report documenting results of the validation period must be completed and available prior to removal of the applicable paper documents.

f. Type C Applications. Type C applications are FAA-approved software using RTCA/DO-178 compliance or other acceptable means. These "non-EFB" software applications are those found in avionics, including intended functions for communications, navigation, and surveillance that require FAA design, production, and installation approval. Develop approved software using the guidance in AC 20-173.

(1) Approved software applications for W&B and/or performance are those applications approved by AIR for a specific aircraft and are approved as part of the AFM or as an AFMS.

(2) Approved software applications will have an FAA-approved AFM or AFMS.

(3) The operator may utilize approved software W&B and/or performance applications on any class of EFB provided the software system requirements are met (refer to AC 20-173). Approved software applications for W&B and/or performance are those applications approved by AIR for a specific aircraft. AIR-evaluated software applications will have an FAA-approved flight manual supplement. Contact the responsible AEG for assistance regarding applications offered by aircraft manufacturers or STC holders for specific aircraft.

(4) A Technical Standard Order Authorization (TSOA) is a dual FAA certification design and production approval with a streamlined approval process. Operators may apply for authorization to use a TSOA for certain Type C applications. You can find a current list of TSOs on the FAA Internet Web site at http://rgl.gov. You will also find the TSO Index of Articles at the same site. Title 14 CFR part 21 subpart O defines the regulatory basis for a TSOA. Type C applications that receive a TSOA may be authorized for use on Class 2 or Class 3 EFBs provided they meet the following conditions:

(a) In-flight depiction of own-ship position is classified as a major safety effect and cannot be formally authorized for use on a Class 1 or Class 2 EFB.

(b) Type A and/or Type B EFB applications may reside with TSOA Type C applications provided they do not interfere with the Type C application(s) (refer to AC 20-173 for guidance).

12. PORTABLE EFB HARDWARE CONSIDERATIONS.

a. Paper Data Removal. Two or more operational EFBs are required to remove paper products that contain Type B software applications for in-flight use (e.g., aeronautical charts, checklists, emergency procedures, etc.) Type A software applications are not subject to this requirement. The design of the EFB function requires that no single failure or common mode error may cause the loss of required aeronautical information.

b. Electrical Power Source. System design must 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 that have aircraft power available for recharging the EFB battery are considered to have a suitable backup power source. EFBs that do not have a battery power source and that are used in place of paper products required by the operating rules are required to have at least one EFB connected to an aircraft power bus. For guidance on the design and installation of aircraft electrical power sources, refer to AC 20-173.

c. Battery Backup. Useful battery life must be established and documented for battery powered EFBs. Aircraft operators must be able to determine the useful life of the EFB battery. Each battery powered EFB providing aeronautical information or software applications pertinent to the safe operation of the aircraft must have at least one of the following before departing the gate:

(1) An established procedure to recharge the battery from aircraft power during flight operations;

(2) A battery or batteries with a combined useful battery life to ensure EFB is operational during taxi and flight operations to include diversions and expected delays; or

(3) An acceptable mitigation strategy, authorized by the principal inspector (PI) with certificate oversight responsibility with concurrence from Air Transportation Division (AFS-200), to ensure products that contain aeronautical charts, checklists, or other data required by the operating rules are available. The certificate holder must submit a plan to the FAA PI assigned with oversight responsibility for subsequent coordination and review with geographically responsible AFS Regional Office (RO) and AFS-200.

d. Battery Replacement. In the case of a replaceable battery, if the EFB manufacturer has not specified a battery replacement interval, then the original battery (or cell) manufacturer's specified replacement interval should be adhered to.

e. 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.

(1) Safety Concerns. These types of batteries are vulnerable to overcharging and over-discharging, which can (through internal failure) result in overheating. Overheating may result in thermal runaway, which can cause the release of either molten burning lithium or a flammable electrolyte. Once one cell in a battery pack goes into thermal runaway, it produces enough heat to cause adjacent cells to also go into thermal runaway. The resulting fire can flare repeatedly as each cell ruptures and releases its contents. For additional information on fighting fires caused by lithium-type batteries in portable electronic devices see SAFO 09013.

(2) Design Recommendation. We recommend the rechargeable lithium-type battery design be compliant with the provisions of the Institute of Electrical and Electronic Engineers (IEEE) 1625-2008, IEEE Standard for Rechargeable Batteries for Portable Computing. 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.

(3) Related Regulations. There are other regulations that may apply to the use of lithium batteries onboard aircraft, including the Department of Transportation (DOT) regulations for air travel found in Title 49 of the Code of Federal Regulations (49 CFR) part 175, § 175.10. DOT regulations do not allow more than 25 grams of equivalent lithium content (ELC) or 300 watt

hours per battery pack in air travel. For more information refer to http://safetravel.dot.gov. DOT regulations apply to the shipment of lithium ion batteries, not to batteries installed in PEDs. However, if spare batteries are carried, operators should refer to current DOT regulations.

(4) Lithium Battery Safety and Testing Standards. Due to their proximity to the flightcrew and potential hazard to safe operation of the aircraft, the use of rechargeable lithium-type batteries in portable EFBs located in the aircraft cockpit call for the following standards. Operators must provide evidence of the following testing standards to determine whether rechargeable lithium-type batteries used to power EFBs are acceptable for use and for recharging. Operators must provide evidence of the standards in subparagraphs 11.e.(4)(a) and either 11.e.(4)(b), (c), or (d) of this AC. Refer to the following current editions:

(a) United Nations (UN) Transportation Regulations.
UN ST/SG/AC.10/11/Rev.5-2009, Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria.

(b) Underwriters Laboratory (UL). UL 1642, Lithium Batteries; UL 2054, Household and Commercial Batteries; and UL 60950-1, Information Technology Equipment - Safety.

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

(c) 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.

(d) RTCA/DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems. An appropriate airworthiness testing standard such as 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. If RTCA/DO-311 is used, then RTCA/DO-311 Table 4-1 and appendix C should be used for guidance on applicable testing.

(5) Showing Compliance. The operator provides the principal inspector (PI) with records of compliance to these battery standards during the authorization to use the EFB. These records may be available from the battery's Original Equipment Manufacturer (OEM).

(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 that the rechargeable lithium-type batteries are sufficiently charged at proper intervals and have periodic functional checks to ensure that 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 or other unintentional exposure or damage that could result in personal injury or

property damage. All replacements for rechargeable lithium batteries must be sourced from the OEM and repairs must not be made.

(7) Use of Aircraft Electrical Power Sources. Appropriate labels should identify the electrical characteristics (e.g., 28 volts direct current (VDC), 1500 milliAmps (mA), 60 or 400 hertz (Hz)) of electrical outlets for Class 2 portable EFB electrical connections. Conduct an electrical load analysis to replicate a typical EFB to ensure that powering or charging the EFB will not adversely affect other aircraft systems and that power requirements remain within power load budgets. Additional actions and application of airworthiness regulations are not applicable to the internal elements of Class 1 and Class 2 EFBs unless specified in this AC. For guidance on the use of aircraft electrical power sources, refer to AC 20-173.

f. Environmental Hazards Identification and Qualification Testing. Certain environmental hazards must be evaluated for Class 1 and Class 2 EFBs to ensure their safe use in anticipated operating environments. Evaluate Class 1 and Class 2 EFB system RF emissions data needs in accordance with AC 91.21-1 and this AC. Class 1 and Class 2 EFBs should demonstrate that they meet appropriate industry-adopted environmental qualification standards for radiated emissions for equipment operating in an airborne environment (RTCA/DO-160, Environmental Conditions and Test Procedures for Airborne Equipment, or its equivalent). It is necessary to demonstrate that any Class 1 or Class 2 EFB used in aircraft flight operations will have no adverse impact on other aircraft systems (noninterference). The manufacturer, installer, or operator may accomplish the testing and validation to ensure proper operation and noninterference with other installed systems. Test for possible interference while moving a portable EFB about in the cockpit. Additionally, rapid decompression testing may need to be accomplished to demonstrate Class 1 or Class 2 EFB operation for use in pressurized aircraft.

(1) Non-EFB Noninterference Testing. It is the user's/operator's responsibility to determine that the operation of a PED will not interfere in any way with the operation of aircraft equipment. AC 91.21-1 addresses noninterference testing for noncritical phases of flight only and is not adequate when an EFB is to remain powered (including being in standby mode) during critical phases of flight. Class 1 and Class 2 EFBs require the additional guidance for noninterference testing contained in subparagraph 11f(2) of this AC, in addition to the guidance in AC 91.21-1.

(2) EFB PED Noninterference Compliance Test Method. In order to operate a PED during all phases of flight, the user/operator is responsible for ensuring that the PED will not interfere in any way with the operation of aircraft navigation and communication system. The following methods are applicable to Class 1 and Class 2 EFBs that are to remain powered (including being in standby mode) during critical phases of flight. The user/operator may use either Method 1, Method 2, or Method 3 for noninterference testing.

(a) Method 1: The two following steps complete Method 1 for compliance with PED noninterference testing for all phases of flight.

1. Step 1 is to conduct an electromagnetic interference (EMI) test in accordance with RTCA/DO-160, section 21, category M. An EFB vendor or other source can conduct this Step 1 test for an EFB user/operator. An evaluation of the results of the RTCA/DO-160 EMI test

can be used to determine if an adequate margin exists between the EMI emitted by the PED and the interference susceptibility threshold of aircraft equipment. If Step 1 testing determines that adequate margins exist for all interference (both front door and back door susceptibility), then Method 1 is complete. It is necessary to complete Step 2 testing if Step 1 testing identifies inadequate margins for interference, or either front door or back door susceptibility. (Front door emissions couple to aircraft system antennas by means of propagation through aircraft apertures such as doors and windows. Back door emissions couple to aircraft equipment, wires, and cables).

2. Step 2 testing is specific to each aircraft model in which the PED will be operated. Test the specific PED equipment in operation on the aircraft to show that no interference of aircraft equipment occurs from the operation of the PED. Step 2 testing is conducted in an actual aircraft, and credit may be given to other similarly equipped aircraft of the same make and model as the one tested.

(b) Method 2: For compliance with PED noninterference testing for all phases of flight, is a complete test in each aircraft using standard industry practices. This should be to the extent normally considered acceptable for noninterference testing of a PED in an aircraft for all phases of flight. Credit may be given to other aircraft of the same make and model equipped with the same avionics as the one tested. In support of Method 2, a PED as EFB - Electromagnetic Compatibility Assessment Checklist has been developed and is located in FSIMS, Publications, Other documents, Electronic Flight Bag Checklists and Job Aids section. The use of this checklist is not mandatory.

(c) Method 3: For compliance with PED non-interference testing for all phases of flight is the methodology described in FAA InFO 13010, Expanding Use of Passenger Portable Electronic Devices (PED) and its supplement FAA InFO 13010SUP, FAA Aid to Operators for the Expanded Use of Passenger PEDS. This guidance is an acceptable means of assessing and mitigating risk pertaining to the use of PEDs in all phases of flight. If an aircraft has been determined to be eligible for all phases of operation, without restriction, for passenger PEDs, then the same determination of electromagnetic compatibility may apply to PEDs that have been authorized for use as EFBs in accordance with OpSpec/MSpec/LOA A061, Use of Electronic Flight Bag. InFO 13010SUP can be downloaded from the following hyperlink: http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/info/all_infos/.

(3) T-PEDs. In order to operate a T-PED in other than a noncritical phase of flight, the user/operator is responsible to ensure that the T-PED will not interfere with the operation of the aircraft equipment in any way. The following method is applicable to Class 1 and Class 2 EFBs that are to remain powered (including being in standby mode) during critical phases of flight. Noninterference testing for T-PEDs consists of two separate test requirements.

(a) Test Requirement 1. Each T-PED should have a frequency assessment based on a representative sample of the frequency and power output of the T-PED. This frequency assessment should consider Federal Communications Commission (FCC) frequency standards and be in accordance with applicable processes set forth in RTCA/DO-294, Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDs) on Aircraft. This frequency

assessment must confirm that no interference of aircraft equipment will occur as a result of intentional transmissions from these devices.

(b) Test Requirement 2. Once a frequency assessment determines there will be no interference from the T-PED's intentional transmissions, test each T-PED while operating using either Method 1 or Method 2 for basic noninterference testing requirements. This basic noninterference testing is applicable to both an EFB-integrated T-PED and a T-PED that is remote to an EFB. When an EFB has an integrated T-PED, complete the basic noninterference testing both with and without the T-PED function being operative. If a T-PED is located remotely from the EFB, the T-PED basic noninterference testing is independent from the EFB noninterference testing. T-PED position is very critical to T-PED noninterference testing. Clearly define and adhere to the operating/testing locations of a T-PED in T-PED operating procedures.

(4) Rapid Decompression Testing.

(a) Environmental Tests. Other environmental testing, specifically testing for rapid decompression, may be necessary. Testing completed on a specific representative EFB make and model configuration may be applied to other EFBs of the same make and model. It is the responsibility of the operator to provide documentation that these tests have been accomplished on at least one representative sample of each make and model of the EFB. 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.

(b) Rapid Decompression Testing. Determining an EFB device's functional capability requires rapid decompression testing when utilizing Type B software applications in pressurized aircraft, unless alternate procedures or a paper backup is available. When using only Type A applications on the EFB, rapid decompression testing is not required. The information from the rapid decompression test is used to establish the procedural requirements for the use of that EFB device in a pressurized aircraft. Rapid decompression testing must comply with RTCA/DO-160 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 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.

1. Pressurized Aircraft. It is necessary to conduct rapid decompression testing for Class 1 and/or Class 2 EFB devices when the EFB has Type B applications and/or is used to remove paper-based aeronautical information in a pressurized aircraft in flight. When a Class 1 or Class 2 EFB has successfully completed rapid decompression while turned on, no mitigating procedure needs to be developed beyond dual redundancy. If a Class 1 or Class 2 EFB device demonstrates rapid decompression testing while turned off and is fully functional following rapid decompression, then procedures will need to be developed to ensure that one of the two EFBs onboard the aircraft remains off or configured so that no damage will be incurred should rapid decompression occur in flight above 10,000 feet.

2. Unpressurized Aircraft. Rapid decompression testing is not required for a Class 1 or Class 2 EFB used in an unpressurized aircraft. The EFB must be demonstrated to reliably operate up to the maximum operating altitude of the aircraft. If EFB operation at maximum operating altitude is not attainable, procedures must be established to preclude operation of the EFB above the maximum demonstrated EFB operation altitude while still maintaining availability of required aeronautical information.

g. EFB Mounting Devices. For guidance on the design and installation of EFB mounting devices, refer to AC 20-173.

h. Stowage Area for EFB. EFB stowage is required for all EFBs not secured in or on a mounting device. If an EFB mounting device is not provided, designate an area to stow the EFB. Stowage requires an inherent means to prevent unwanted EFB movement when not in use. Do this in a manner that prevents the device from jamming flight controls, damaging flight deck equipment, or injuring flightcrew members should the device move about as a result of turbulence, maneuvering, or other action. The stowage area should not obstruct visual or physical access to controls and/or displays, flightcrew ingress or egress, or external vision. Acceptable stowage locations for a Class 1 EFB include the inside compartments of the pilot's stowed flight bag.

i. Data Connectivity with Aircraft Systems (Wired or Wireless). For guidance on the design and installation of any EFB data connectivity with aircraft systems, either wired or wireless, refer to AC 20-173. Hardware and software for data connection provisions and interface protection devices must be incorporated into the aircraft type design per AC 20-173.

13. EFB SYSTEM DESIGN CONSIDERATIONS.

a. EFB System Design and Usability. It is necessary to evaluate the human factors/pilot interface characteristics of the EFB system. Special attention should be paid to new or unique features that may affect pilot performance.

b. Human Machine Interface (HMI). 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 and various hosted applications.

c. Legibility of Text. Text 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 a flight deck, including use in direct sunlight. 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 in the flight deck. Buttons and labels should have adequate illumination for night use. All controls must be properly labeled for their intended function. Consideration should be given to long-term display degradation as a result of abrasion and aging. The EFB should not produce objectionable glare or reflections that could adversely affect the pilot's visual environment.

d. Electronic Display of Aeronautical Charts.

(1) Electronic aeronautical charts should provide a level of information comparable to paper charts.

(a) Visual, instrument, and aerodrome charts (refer to International Civil Aviation Organization (ICAO) Annex 4) that are depicted should contain the information necessary, in appropriate form, to conduct the operation at a level of safety that is at least equivalent to that 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.

(b) The screen must display an instrument approach procedure (IAP) chart in an acceptable aeronautical chart format similar to a published paper chart. 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 that of a paper chart. 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 AEG for functionality and human factors.

(c) Aeronautical navigation charts (i.e., visual flight rules (VFR) navigation charts, low and high altitude en route charts, and terminal procedure publications) will need to be evaluated for operational suitability. Panning, scrolling, zooming, rotating, or other active manipulation is permissible for these Type B applications. An EFB display may 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. 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.

NOTE: Software with an airworthiness approval performing an intended function of aeronautical charting as a replacement for paper could be utilized to support operational requirements without the need for further operational evaluation for use, provided it meets the EFB system design configuration considerations in this paragraph.

(2) The FSB/OSR report should include, but not be limited to, the following:

- Aeronautical information operational suitability;
- Pilot workload in both single-pilot-flown and multicrew-flown aircraft;
- Size, resolution, and legibility of symbols and text;
- Access to desired charts;
- Access to information within a chart;
- Grouping of information;
- General layout;
- Orientation (e.g., track-up, north-up);
- Depiction of scale information; and

- Training, checking, and currency requirement.

e. Database Accuracy and Quality. Database errors can have a significantly greater impact on the flightcrew than other elements of the EFB system. With this in mind, the EFB system 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-200A, Standards for Processing Aeronautical Data. Databases utilizing raster aeronautical charts should use the guidance in RTCA/DO-257A, 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 must be provided. For Type B software applications displaying own-ship position intended for airport surface operations, design of the system should never exceed a maximum total error budget of 40 meters accuracy for the combination of database error and position source error. The 40 meter accuracy requirement is based on half the separation of taxiways at aerodrome code letter E as specified in ICAO Annex 14. 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.

f. Own-Ship Position Source and Display Characteristics. The use of an installed Global Navigation Satellite System (GNSS) position source is recommended. Portable EFBs with no data access to installed aircraft systems may consider use of a portable (internal or external) GNSS source, pending completion of a successful evaluation Type B software applications which display own-ship position limited to airport surface operations may be utilized pending successful evaluation of the application software for operational suitability and must be tested and proven accurate by the applicant utilizing the Type B Electronic Flight Bag (EFB) Software Application(s) Displaying Own-ship Position Limited to Airport Moving Map for Surface Operations: Aircraft Operator Checklist and FAA Principal Inspector (PI) Job Aid which can be downloaded from the FAA's Web based Operations Safety System (WebOPSS) paragraph A061 guidance tab, or FSIMS, Publications, Other documents, Electronic Flight Bag Checklists and Job Aids section. To display own-ship position, the Type B application software must incorporate the following design features and limitations:

(1) Airborne Display. Removal of own-ship when calculated speed exceeds 80 kts ground speed. This ensures no own-ship when airplane is airborne, even if aircraft is within the airport diagram boundary.

(2) Airport Map. For design of an AMMD with own-ship depiction, we recommend using appropriate elements of RTCA/DO-257A. When developing the AMMD application and the data quality requirements, the applicable requirements of RTCA/DO-272C, User Requirements for Aerodrome Mapping Information, section 3 should be utilized. Type B application software displaying own-ship position limited to airport surface operations must perform its intended function and not create a hazard to the aircraft or its occupants. Controls, labeling, use of colors, symbology, behavior, responsiveness, and map features should follow the guidance in RTCA/DO-257A and may need to be evaluated for operational suitability by the

FSB process. Any additional intended functions displaying own-ship position, which are limited to airport surface operations only and a minor failure condition classification, should address performance standards established for those functions and perform its intended function so as to not create hazard to the aircraft or its occupants.

(3) Directionality. Change own-ship to a non-directional (circular) depiction when heading is not available or cannot be calculated based on GNSS data.

(4) GNSS Data Stream. Remove own-ship if the GNSS data stream stops. This guards against a "frozen" own-ship condition caused by position source signal loss with the EFB, or the GNSS device losing charge/power source. Design the EFB system to monitor the GNSS data stream health for a regular stream of position updates (e.g., every second for systems updating at 1 Hz). Remove own-ship if the GNSS position doesn't update as expected for three consecutive update cycles (e.g., three seconds for systems updating 1 Hz).

(5) GNSS Accuracy. Remove own-ship if GNSS source is indicating accuracy exceeding its part of the maximum allocation (e.g., for systems utilizing a total error budget of 40 meters, with 25 meters being allocated to database error, the maximum allocation for position source accuracy would be 15 meters).

(6) Map Zoom. Design the application to include a maximum zoom limitation to help visually constrain and highlight the display of own-ship position is insufficient to directly support maneuvering. The level of zoom should be limited to providing supplemental position awareness only. Ensure the range of display zoom level is compatible with the position accuracy of the ownship symbol.

(7) Visual Check Training. Crewmember training, to use display of own-ship position on the airport surface, should include visual check procedures to require the pilot to do visual checks of outside airport signage and markings against the depicted airport map to verify the own-ship symbol is shown at that same location. Training should also include proper error reporting procedures for crewmembers when visual checks reveal display discrepancies.

g. Responsiveness of Application. The system should provide feedback to the user when user input is accepted. If the system is busy for an atypical time with internal tasks that preclude 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 that the system is occupied and cannot process inputs immediately. The timeliness of system response to user input should be consistent with an application's intended function. The feedback and system response times should be predictable to avoid flightcrew distractions and/or uncertainty.

h. Offscreen Text and Content. If the document segment is not visible in its entirety in the available display area, such as during "zoom" or "pan" operations, the existence of offscreen content should be clearly indicated in a consistent way. For some intended functions 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 function. 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).

i. 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.

j. Managing Multiple Open Applications and Documents. The electronic document 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 document is the one that is currently displayed and responds 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 flight deck applications are running and switch to any one of these open applications easily. When the user returns to an application that was running in the background, it should appear in the same state as when the user left that application, other than differences associated with the progress or completion of processing performed in the background.

k. Input Devices. All controls must be within reach of the appropriate crewmember seated normally on the flight deck. In choosing and designing input devices such as keyboards 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 that could affect the usability of that input device. Typically, the performance parameters of cursor-control devices are tailored for the intended application function as well as for the flight deck environment. Input devices should provide feedback to indicate when operational.

l. Flightcrew Workload. The EFB software design should minimize flightcrew workload and head-down time. The positioning, use, and stowage of the EFB should not result in unacceptable flightcrew workload. Avoid complex, multi-step data entry tasks during takeoff, landing, and other critical phases of flight. An evaluation of EFB intended functions should include a qualitative assessment of incremental pilot workload, as well as pilot system interfaces and their safety implications. If the intended function of an EFB includes use during critical phases of flight, such as during takeoff, landing, or abnormal and emergency operations, its use should be evaluated during simulated or actual aircraft operations under those conditions.

m. 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 available to the user upon request. Certain nonessential applications such as email connectivity and administrative reports may require an error message when the user actually attempts to access the function, rather than an immediate status annunciation when a failure occurs. EFB status and fault messages should be prioritized and the message prioritization scheme evaluated and documented.

n. 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 that communicates which entry is suspect and specifies what type of data it expects. The EFB system and application software should incorporate input error checking that detects input errors at the earliest possible point during entry, rather than on completion of a possibly lengthy invalid entry.

o. Error and Failure Modes.

(1) Flightcrew Error. The system design should minimize the occurrence and effects of flightcrew error and maximize the identification and resolution of errors. 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.

(2) Identifying Failure Modes. The possible effects of undetected errors in each EFB application should be evaluated. The assessment should address the adequacy of the HMI, accessibility of controls, ability to view controls, annunciations, displays and printers, and the effect on flightcrew workload and head-down time. The assessment should also consider the effects of flightcrew (procedural) errors determined by comments from the professional pilot community. The EFB system should be capable of alerting the flightcrew of probable EFB application/system failures.

p. Integrity Considerations. The operator must demonstrate that the EFB performs its intended functions. Additionally, data contained in the data files should be of sufficient integrity to perform the intended functions without producing false or hazardously misleading information. 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 validation period. It is subsequently maintained through data updates and software revision procedures.

14. AUTHORIZATION PROCESS. The introduction and use of EFBs in the cockpit/flightdeck and cabin of parts 91K, 121, 125, and 135 operations require authorization from the PI. This requirement includes FAA evaluation of all operating procedures, pertinent training modules, checklists, operations manuals, training manuals, maintenance programs, minimum equipment lists (MEL), other pertinent documents, and reporting procedures.

a. Part 91F Operations. This guidance material also applies to operators of large and turbine-powered multiengine aircraft operating under part 91F where the operating regulations require specific functionality and/or equipage. Part 91F operations do not require any specific authorization for EFB operations provided the EFB does not replace any system or equipment required by the regulations. This AC provides guidance for all EFB equipages. In order for a PED to be considered an EFB, its functions must conform to the guidance in this AC.

b. General Process for Approval or Acceptance. FAA Order 8900.1, Volume 3, Chapter 1, The General Process for Approval or Acceptance, and FAA Order 8900.1, Volume 4, Chapter 15, Electronic Flight Bag Authorization for Use, contain instructions for the completion of a five-phase process. The process leads to formal operational authorization and consists of the following five phases:

(1) Phase 1 of the process begins when an operator requests authorization from the FAA. The FAA and the operator should reach a common understanding of what the operator must do, what role the FAA will have, and what reports and documents will be included as part of the authorization process.

(2) Phase 2 begins when the operator submits a plan to the FAA for formal evaluation. During this phase, the FAA must ensure that the plan is complete and in an acceptable format before it can conduct a thorough review and analysis. The operator coordinates the plan with the PI or other inspectors, as assigned. The PI or other assigned inspectors will facilitate coordination with the AEG and the Aircraft Certification Office (ACO), as necessary.

(3) Phase 3 begins when the FAA starts its indepth review and analysis of the operator's plan for regulatory compliance, safe operating procedures, logical sequence, and other areas (e.g., flightcrew and dispatcher qualifications, acceptable procedures, and schedules for accomplishment).

(4) Phase 4 is the major phase of the process and involves validation testing. In this phase, the operator conducts specific operations for the purpose of data collection or for FAA observation purposes. Phase 4 concludes when the operator provides sufficient proof to satisfy the FAA's requirement for meeting all the plan objectives or when the operator is unable to complete them satisfactorily.

(5) Phase 5 begins after the successful completion (or termination) of the validation phase. In this phase, the FAA grants authorization for those elements in the validation plan that were successfully completed and documented, or sends the operator a letter of disapproval for those elements that were not completed or that were terminated. The PI grants authorization for the operational use of the EFB through the issuance of OpSpec A061, Use of Electronic Flight Bag. Refer to FAA Order 8900.1, Volume 3, Chapter 18, Section 3, Part A Operations Specifications—General.

c. Operator Responsibilities. In addition to close coordination with the local Flight Standards District Office (FSDO), certificate management office (CMO), and certificate management unit (CMU), to obtain authorization for EFB use, the following steps (in chronological order) are suggested:

(1) For certificate holders, make written application in a form and manner acceptable to the FAA.

(2) Demonstrate a fault and anomaly reporting process to ensure initial and continuing reliability for each EFB.

(3) Demonstrate that the radio magnetic interference/EMI tests have been performed satisfactorily.

(4) Demonstrate that the EFBs can be properly stowed, secured, and/or mounted in the aircraft.

(5) Demonstrate that any electronic receptacles used for connection of the EFB to an aircraft system have been installed using FAA-approved procedures.

(6) Demonstrate that successful rapid decompression testing has been accomplished, if applicable.

(7) Develop policies and procedures that may include, but are not limited to, the following:

- For single-pilot- and multicrew-flown aircraft, appropriate procedures for EFB use during all phases of flight;
- Procedures to follow when one unit fails (where multiple units are carried onboard the aircraft);
- Procedures to follow when all units fail (the procedures should specifically identify alternate means for obtaining data);
- A revision process procedure/method that ensures appropriate database accuracy and currency;
- Courseware to be used while conducting training;
- Procedures that document the knowledge of the user (e.g., training received, evaluation forms, test results);
- A list of the software and data loaded and maintained in each unit; and
- Instructions for continued airworthiness (ICA) in accordance with the manufacturer's recommendations (also include these instructions in the inspection/maintenance program).

(8) Operators transitioning to a paperless or reduced-paper cockpit should carry paper backups of all the information on the EFB during a validation period. The backup information should be readily available to the crew. During this period the operator should validate that the EFB is as available and reliable as the paper-based system being replaced.

(9) For certificate holders, this validation period should include a 6-month operational test evaluation where the EFB system(s) will be available to the crew with all appropriate backup products. The backup products and the EFB are not used simultaneously during the evaluation period, but the backup products are available if needed. Reductions to the required EFB 6-month operational validation testing may be considered if the certificate holder has previous experience with EFBs. A request to reduce the 6-month operational validation testing requires approval from AFS-200. The certificate holder must submit a plan with justification to reduce the 6-month operational validation testing to the FAA PI assigned with oversight responsibility for subsequent coordination and review with the geographically responsible AFS RO and AFS-200.

(10) The operator will issue a final report detailing the training effectiveness, operational effectiveness, and reliability of the EFB.

d. Operational Procedures Development.

(1) EFB Intended Function. The intended function(s) of EFBs may vary depending on the device used and the software applications hosted by the computer. It is extremely important that the operator specifically define the intended EFB functions in a clear and concise manner. Operational procedures developed to achieve a specific intended function or use should consider the applications listed in the attached appendices.

(2) Operator Responsibilities. Operators will be expected to:

(a) Have procedures that define expectations of how the flightcrew should use each EFB function during ground operations and under all flight conditions;

(b) Provide the procedures to flightcrews;

(c) Provide procedures for normal, abnormal, and emergency use; and

(d) Review and determine whether to modify those existing policies and procedures affected by the introduction of EFBs into line operations.

(3) Procedural Considerations.

(a) Procedures for Using EFBs with Other Flight Deck Systems. Flightcrew procedures will ensure that the flightcrew knows what aircraft system to use for a given purpose, especially when both the aircraft and EFB are providing similar information. Procedures should also be designed to define the actions to be taken when information provided by an EFB does not agree with that from other flight deck sources or when one EFB disagrees with another. If an EFB simultaneously displays information that an existing cockpit automation displays, procedures to identify which information source will be primary and which source will be secondary need to be developed (as well as procedures to identify under what conditions to use the backup source). Whenever possible and without compromising innovation in design and use, EFB/user interfaces should be consistent (but not necessarily identical) with the flight deck design philosophy.

(b) Flightcrew Awareness of EFB Software/Database Revisions. The operator should have a procedure in place to allow flightcrews to confirm the revision numbers and/or dates of EFB flight databases and software installed on their units for each flight. (Databases that do not adversely affect flight operations such as maintenance log forms, a list of airport codes, or a captain's atlas, for example, do not require the confirmation of revision dates by flightcrews.) 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.

(c) Procedures to Mitigate and/or Control Workload. Procedures that mitigate and/or control additional workloads created by using an EFB will need to be addressed.

(d) Defining Responsibilities for Performance Calculations. The operator should develop procedures that define any new roles that the flightcrew and dispatch may have in creating, reviewing, and using performance calculations supported by EFBs.

(e) Shutdown Procedures. Shutdown procedures for EFBs should:

- Be incorporated into normal flightcrew shutdown checklist procedures.
- Allow the EFB operating system and hosted applications to remain stable after multiple startups and shutdowns.

e. EFB Configuration Control. The operator's EFB specification documents must list the make and model of the authorized EFB equipment and include at least the following configuration information, which is also required to support OpSpec A061:

(1) Operating system to include version control;

(2) Application program version control;

(3) Approved source for the database updates;

(4) Make and model of EFB hardware (see note below); and

(5) Make and model of the EFB hardware, including a tracking process for major internal subcomponents whose replacement/upgrade may necessitate additional noninterference testing.

NOTE: Permanently sealed tablet computing devices that have no interchangeable internal parts are tracked by make and model or part number of the device hardware itself (e.g., Make: Apple/Model: A1396).

f. Mitigation Strategy. During the transition period to a paperless cockpit, an operator will need to establish a reliable backup means of providing the flightcrew with the information required by the regulations. During this period, an EFB must demonstrate that it produces records that are as available and reliable as those provided by the current paper information system. Operators should establish procedural mitigations to provide a reliable means of displaying information that is required by the operating rules to the flightcrew. This will ensure an equivalent level of safety and integrity to that of the current paper-based products. Mitigation may be accomplished by a combination of the following:

(1) System design;

(2) Separate and backup power sources;

(3) Redundant EFB applications hosted on different EFB platforms;

(4) Paper products accessible for use by crewmembers; and/or

(5) Procedural means.

g. Procedural Mitigations. If one or more onboard EFBs fail, resulting in loss of function or the presentation of false or hazardously misleading information, a contingency plan or process will need to be in place to provide the required information. For example, as a backup to eliminating printed approach charts, an acceptable transition to a paperless cockpit could include the following:

- Carrying paper products for a given time period to validate EFB reliability by quantitative means;
- Using a printing device to print all applicable data required for the flight; or
- Using an aircraft fax machine to uplink equivalent paper documents to the cockpit.

h. Removal of Paper-Based Information. The risk mitigation process must be completed prior to removal of the paper-based information associated with a particular EFB application. These requirements also apply to an operator who intends to begin operation of any aircraft type without paper-based information.

i. Database Update Process.

(1) The operator needs to establish a method for revising EFB databases. The method of data revision should ensure integrity of the data that the operator loads and not negatively impact the integrity of the EFB operation. Especially when using Internet and/or wireless means, procedures must exist to protect the EFB data from corruption. Database revisions do not include application software or operating system changes. Application software and/or operating system program changes must be controlled and tested prior to use in flight. Operators should not perform database and/or application software changes during operations (taxi, takeoff, in-flight, and landing).

(2) Operators also need to establish revision control procedures so that flightcrews and others can ensure that 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 that is subject to a revision cycle control process, it should be readily evident to the user which revision cycle is currently loaded into the EFB.

j. Software Revision Process.

(1) It is the responsibility of the operator and/or the application software vendor to ensure that its operating system and Type A and Type B application programs meet the intended function. Unauthorized modification of any database, or the loading of any new or additional software intended for operational use is not permitted unless that software can be demonstrated to comply with the original intended use. For Type C applications, operators should use FAA-approved Service Bulletins (SB) or the minor change process defined in the current editions of AC 21-40, Guide for Obtaining a Supplemental Type Certificate, or FAA Order 8110.4, Type Certification. 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 for doing this is to ensure that each PIC becomes familiar with all available information concerning that flight, to include receipt of appropriate Notices to Airmen (NOTAM) prior to departure and prior to arrival.

(2) The operator should identify a means to demonstrate that adequate security measures are in place to prevent malicious introduction of unauthorized modifications to the EFB's operating system, its specific hosted applications, and any of the databases or data links used to enable its hosted applications (i.e., security risk assessment). The operator also needs to protect the EFB from possible contamination from external viruses.

k. Special Data Storage and Retrieval Considerations.

(1) The EFB needs to 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 the NTSB require an operator to provide information, the operator must provide the data in a format that the requesting agency can use.

(2) Operators should establish procedures to archive or retain old data. For archived data, the length of time that the data is kept depends on the kind of information being archived. Some information, such as maintenance historical data, should be kept for the life of the aircraft. It may also be necessary to keep old versions of software and operating systems to properly retrieve archived data. Operators should download maintenance discrepancy logs into a permanent record at least weekly.

l. Training. Training should reflect the level of the functionality and complexity as agreed upon by the operator and the PI. Training should address flightcrew and maintenance personnel requirements, as appropriate.

(1) Aviation safety inspectors (ASI) may wish to reference applicable FAA/Industry Training Standards (FITS) to determine the best practices for training and use of the EFB in a manner pertinent to parts 91F and 91K operations. Determine the appropriate FITS program in consultation with the equipment manufacturer and/or the General Aviation and Commercial Division (AFS-800) at FAA headquarters (HQ) in Washington, DC.

(2) Certificated operators requesting to conduct operations using EFB cockpit applications should use the training guidance in FAA Order 8900.1 Volume 3, Chapter 19, Training Programs and Airman Qualifications. FAA guidance requires all parts 121 and 135 operators to develop a curriculum segment for the EFB, which may consist of a ground training simulation and, if needed, a flight training segment. The EFB curriculum segment should include an outline of the training, appropriate courseware, and the instructional delivery method. Each EFB training module should include the following elements:

(a) A description of the EFB, its capabilities, and the applications for which the operator will use the EFB and its components and peripherals. This should include theory of operation, and the training should ensure that flightcrews understand the dependencies associated with the sources and limitations of the information.

(b) A description of EFB controls, displays, symbology, and failure modes. EFB failure modes and flightcrew procedures should include a description of the EFB (e.g., EFB processor, switches, and installed databases, such as an airport surface or en route moving map). If color is a significant EFB application feature, then training materials should include color illustrations.

(c) An AFMS or another form of documentation that provides conditions, limitations, and procedures for the use of the EFB and its associated equipment. For instance, operators should train flightcrews on how to ensure that the airport charts and manuals are current, and what to do if they find that the software and/or databases are out-of-date. Only EFB provisions (mounts, wiring, etc.) for Class 2 EFBs or installation for Class 3 EFBs require an AFMS, unless approved by a TSO. Class 1 and Class 2 EFBs and Type A and Type B EFB applications may

require an alternative means of documentation that provides conditions, limitations, and procedures for use.

(d) Descriptions of authorized special flight maneuvers, operations, and procedures that the operator conducts when using an EFB.

(e) Any special pilot/controller procedures when using EFB-based information.

(f) Geographical areas authorized for specific EFB operations, if applicable.

(g) Authorized methods to defer inoperative EFB equipment.

(3) Operator training should also provide an opportunity for instruction, demonstration, and practice using the actual or simulated EFB equipment and displays. Base the EFB qualification curriculum segment (required for parts 121 and 135 operators) on functionality and complexity as agreed upon by the operator and the PI. In addition, EFB components installed in accordance with applicable airworthiness regulations may contain EFB training guidance in the airplane's FSB report.

(4) Parts 121 and 135 operators are required to conduct initial fleet training. PIs will issue a letter authorizing an operator to instruct personnel under the EFB curriculum segment, pending an evaluation of training effectiveness. This also allows FAA inspectors who are responsible for certificate management to become familiar with the operator's EFB and equipment. After the PI evaluates the operator's EFB curriculum segment and determines that it is satisfactory, the PI issues an interim authorization to the operator. This authorizes the operator to continue training in accordance with the operator's approved training program.

m. Pilot Training Program.

(1) Parts 91K, 121, and 135 Operators. Except when under the supervision of an appropriately trained check pilot, the flightcrew may need to complete an approved training program before being authorized to use the EFB equipment. However, flightcrew members should have satisfactorily completed the ground school portion of the EFB training program, if required. Training as outlined in this AC is only applicable to those flightcrew members that actually operate the equipment. Training is not required of crewmembers that are not authorized to use the equipment, even though it may be installed in the aircraft, unless it is operated under the supervision of a check pilot. For air carrier operations, initial qualification with the EFB may require that the flightcrew members demonstrate satisfactory proficiency with the EFB to an FAA inspector or check pilot; this may be completed during a line check.

(2) Part 125 Operators. Although no training program requirements exist for part 125 operators, the flightcrew members should have satisfactorily completed the ground school portion of the EFB training program before performing under the supervision of a check pilot (part 125) or evaluation by an authorized instructor. The PI may authorize an individual (e.g., the company chief pilot, company check pilot, or training course provider) to complete this evaluation. The flightcrew must have a satisfactory evaluation of their performance in the use of the EFB in flight before using the equipment in normal operations.

(3) Part 91F Operators. The primary source of operational and training guidance will be provided through the FITS, which can be obtained through the equipment manufacturer or AFS-800 at Washington HQ. The appropriate FITS program may be used to determine the appropriate best practices for familiarization with and use of the equipment. Each operator's EFB program should identify and document user training in support of the use of an EFB.

n. Simulator and Flight Evaluations.

(1) Simulator Evaluations. Simulators and other approved training devices (e.g., procedures trainers) may be used as a tool to evaluate the overall quality of the training given and/or to evaluate EFB performance before granting authorization for use. The level of simulation fidelity required depends upon the type of use/credit being sought. Some of the EFB characteristics and flight deck integration issues that should be evaluated via simulation include:

- The flightcrew's use of displays;
- EFB control use;
- Alert reactions;
- Auto-ranging configuration;
- Self-tests;
- Flightcrew procedures; and
- Failure mode analysis.

(2) Flight Evaluations.

(a) Base the number of flight evaluations required to validate a particular EFB before authorizing its use (including its hosted applications) on:

- Type of aircraft;
- Aircraft system architecture;
- Flightcrew workload considerations;
- Credit given for previously certified installations; and
- Past simulator and ground testing.

(b) The PI needs to evaluate the actual requirement for a flight test for each request. The PI will determine if an approved training device or an actual flight evaluation is required. If adequate evaluation of changes in the EFB, including software upgrades, is not possible on the ground or in simulators, it may require flight-testing.

o. Need for Approved Manuals. The aircraft must carry an FAA-approved AFMS onboard at all times when the EFB equipment is installed in accordance with applicable airworthiness regulations. However, § 121.141 permits an operator to carry a manual that meets the requirements of § 121.133 onboard a transport category aircraft in lieu of the AFM, provided that the manual contains all AFM/AFMS limitations and identifies them as AFM/AFMS requirements. These manuals can be in an electronic format provided the operator has paperless authorization for the AFM and/or company manual.

p. ICAs.

(1) Although a source independent of the operator may provide ongoing maintenance and support for EFB equipment, the operator is responsible for compliance with all regulatory requirements.

(2) The maintenance or inspection program should identify inspection items, establish time-in-service intervals for maintenance and inspections, and provide the details of the proposed methods and procedures. The maintenance or inspection program should also include ICAs for the STC or FAA design or installation approval.

(3) It is important for operators to coordinate with their PI on airworthiness-related considerations early in the process to determine the appropriate authorizations necessary for each EFB application.

q. MELs. Operators may update their MELs to reflect the installation of this equipment. Changes made to the operator's MEL should be made in accordance with the approved Master Minimum Equipment List (MMEL).

r. EFB Substitution/Use in More Than One Aircraft. The operator may substitute compatible EFBs for use in other aircraft. Specific procedures are necessary to ensure that an EFB is fully compatible with other aircraft and their systems prior to placement into service. It is also necessary to develop procedures to ensure that any aircraft-specific data captured in EFB memory is archived for that aircraft when the EFB moves to another aircraft.

s. User Feedback. Parts 121 and 135 operators should implement a formal process for gathering feedback. Use this process during design, installation, modifications, or improvements to procedures and/or training.

t. Paperless Authorization.

(1) Certificated Operators. FAA Order 8900.1, Volume 3, Chapter 18, Section 3, OpSpec A061, and Volume 4, Chapter 15, contain general policy guidance and requirements for obtaining authorization for use of EFBs by certificated operators. The issuance of OpSpec A061 gives operational authorization for an air carrier or commercial operator who intends to use EFBs for flight operations. It may be necessary to issue or amend other OpSpecs, as appropriate. The OpSpec must reference the company documents, records, or manuals presented with the operator's application.

(2) Part 91F (Noncertificated Operators). EFBs used in part 91 operations in lieu of paper reference material are authorized for the intended functions provided the EFBs meet the criteria set forth in this AC. The evaluation and suitability for in-flight use of an EFB in lieu of paper reference material is the responsibility of the aircraft operator and the PIC. Any Type A or Type B EFB application, as defined in this AC, may be substituted for the paper equivalent. It requires no formal operational approval as long as the guidelines of this AC are followed.

(a) Any Type A or Type B EFB application, as defined in this AC, may be a substitute for the paper equivalent. When the EFB replaces aeronautical information required by

14 CFR part 91, then a secondary or backup source of aeronautical information necessary for the flight must be available to the pilot in the aircraft. The secondary or backup information may be either traditional paper-based material or displayed electronically by other means.

(b) The aircraft operator and/or PIC are responsible for showing compliance with all the requirements of subparagraph 13.c in this AC. This should be in written form onboard the aircraft. The EFB system onboard must be functionally equivalent to the paper reference material which the information is replacing. The pilot verifies that all information used for navigation, aircraft operation, or performance planning is current, up-to-date, and valid.

(c) The aircraft operator and/or PIC is responsible for making an assessment of the human/machine interface and aspects governing Crew Resource Management (CRM) in accordance with the human factors considerations of this AC. This requires training in EFB procedures and use, preflight checks of the system, the use of each operational function on the EFB, and procedures for cross-checking data entry and computed information. Also included in this training are the conditions (including phases of flight) when EFB use should be terminated.

u. Electronic Authorization. Final authorization for use of electronic documents, in lieu of required paper documents, requires:

(1) Operational evaluation completion, including the validation report;

(2) Reliable EFB information available for each flightcrew member;

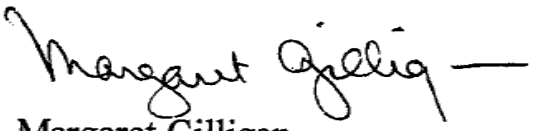
(3) Compliance with FSB reports and/or OSRs, if available;

(4) EFB maintenance and fault reporting procedures in place;

(5) Noninterference testing as specified within AC 91.21-1 and this AC;

(6) Results from rapid decompression testing and related mitigating procedures when the EFB system hosts applications that are required to be used during flight following a rapid decompression; and

(7) OpSpec A061 authorization, as appropriate.



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Aviation Safety

APPENDIX 1. EXAMPLES OF TYPE A ELECTRONIC FLIGHT BAG (EFB) APPLICATIONS REQUIRING PRINCIPAL INSPECTOR (PI) AUTHORIZATION

- Flight Operations Manual (FOM). (If no flight operating procedures.)
- Flight Attendant (F/A) manuals. (If no flight operating procedures.)
- Company standard operating procedures (SOP).
- Airport diversion policy guidance, including a list of special designated airports and/or approved airports with Emergency Medical Services (EMS) support facilities.
- Operations specifications (OpSpecs).
- Cockpit observer briefing cards.
- For smaller aircraft, pilot's operating handbooks (POH), including POH section IX supplements.
- Aircraft performance data manuals (fixed non-interactive material).
- Airport performance restrictions manual (e.g., a reference for takeoff and landing performance calculations).
- Weight and Balance (W&B) manual, if a separate manual (fixed non-interactive material).
- Other aircraft performance data manuals, including specialized performance data for use in conjunction with advanced wake vortex modeling techniques, land-and-hold-short operations (LAHSO) predictions, etc. (fixed non-interactive material for planning purposes).
- Maintenance manuals.
- Aircraft maintenance reporting manuals.
- Aircraft flight log and servicing records.
- Autopilot approach and autoland records.
- Flight management system (FMS)/flight management and guidance system problem report forms.
- Aircraft parts manuals.
- Service Bulletins (SB)/published Airworthiness Directives (AD), etc.
- Airlines of America (ATA) 100-format maintenance discrepancy writeup codes.
- Required Very high frequency Omnidirectional Range (VOR) check records.
- Minimum equipment lists (MEL).
- Configuration Deviation Lists (CDL).
- Federal, state, and airport-specific rules and regulations.
- Airport/Facility Directory (A/FD) data (e.g., fuel availability, LAHSO distances for specific runway combinations, etc.).
- Noise abatement procedures for arriving and departing aircraft.
- Published (graphical) pilot Notices to Airmen (NOTAM).
- International Operations Manuals, including regional supplementary information and International Civil Aviation Organization (ICAO) differences.
- Aeronautical Information Publications (AIP).
- Aeronautical Information Manual (AIM).
- Oceanic navigation progress logs.
- Pilot flight and duty-time logs.
- Flightcrew required rest logs.

- Flightcrew qualification logs (such as aircraft qualifications, Class II flightcrew 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 and special airports qualifications).
- Captain's report (i.e., captain's incident reporting form).
- Flightcrew survey forms (various).
- EMS reference library (for use during medical emergencies).
- Trip scheduling and bid lists.
- Aircraft captain's logs.
- Aircraft's CAT II/CAT III landing records.
- Antiterrorism profile data.
- Hazardous materials (hazmat)/oxidizer look-up tables.
- ICAO DOC 9481, Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods.
- Customs declaration and United States Department of Agriculture (USDA) agriculture inspection/clearance form.
- 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.
- Incidents of interference to aircraft electronic equipment from devices carried onboard aircraft.
- Current fuel prices at various airports.
- Realistic training modules, including "personal computer (PC) at home" training applications, "off-duty" training materials review, and preflight "mission" rehearsals.
- Check pilot and flight instructor records.
- Aircraft operating and information manuals (performance information, W&B, systems, limitations, etc.).
- Airline Policy and Procedures Manuals (PPM).
- Aircraft Maintenance Manuals (AMM).
- Title 14 CFR.
- Look up and completion of various reporting forms; e.g., company-specific forms, NASA's ASRS reports, NMAC reports, wildlife strike and hazard reports.
- Maintenance personnel signoff of discrepancy form. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Flightcrew qualifications recordkeeping, including aircraft qualifications, CAT II/III, high minimums, landing currency, flight time and duty-time, etc.
- PIC currency requirements.
- 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, flights being held for connecting passengers).
- Cabin maintenance writeups. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)

- Approved electronic signature using public key infrastructure (PKI) or private key technology.

Appendix 2. Examples Of Type B Electronic Flight Bag (Efb) Applications Requiring Principal Inspector (Pi) Authorization For Use

- Airplane Flight Manuals (AFM) (or Rotorcraft Flight Manuals (RFM)) and Airplane Flight Manual Supplement (AFMS).
- Flight Attendant (F/A) manuals that include flight operating procedures.
- Flight Operations Manuals (FOM), including emergency procedures.
- Company FOMs.
- 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.
- Power settings for reduced thrust settings.
- Runway limiting performance calculations.
- Cost index modeling.
- Master flight plan/updating.
- Interactive plotting for Class II navigation.
- Mission rehearsals.
- Weight and Balance (W&B) calculations.
- Maintenance discrepancy signoff logs. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Cabin maintenance discrepancy reporting forms/location codes. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Non-interactive electronic approach charts in a precomposed format from accepted sources.
- Panning, zooming, scrolling, and rotation for approach charts.
- Precomposed or dynamic interactive electronic aeronautical charts (e.g., en route, area, approach, and airport charts) including, but not limited to, centering and page turning, but without display of airborne aircraft/own-ship position.
- Precomposed or dynamic interactive airport surface electronic aeronautical charts (e.g., airport moving maps) including, but not limited to, centering, page turning, and airport surface aircraft/own-ship position at speeds less than 80 knots (kts), but without display of airborne aircraft/own-ship position (i.e., not appropriate for: surface navigation, surface alerting, time-based operations, guidance, maneuvering, and control functions, etc.).
- Electronic checklists (ECL), including normal, abnormal, and emergency. Refer to the current edition of Advisory Circular (AC) 120-64, Operational Use and Modification of Electronic Checklists, for additional guidance. EFB ECLs cannot be interactive with other aircraft systems.
- Applications that make 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, unscheduled maintenance scheduling, etc. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Weather and aeronautical data.
- Aircraft cabin and exterior video surveillance displays.

Appendix 3. Related Reading Materials

1. ADVISORY CIRCULARS (AC) (current editions). You can find ACs on the MyFAA employee Web site at https://employees.faa.gov. Operators and the public may find this information at http://www.faa.gov/regulations_policies/advisory_circulars.

- AC 00-62, Internet Communications of Aviation Weather and NOTAMs.
- AC 20-115, Radio Technical Commission for Aeronautics, Inc., Document RTCA/DO-178.
- AC 20-140, Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services (ATS).
- AC 20-159, Obtaining Design and Production Approval of Airport Moving Map Display Applications Intended for Electronic Flight Bag Systems.
- AC 20-173, Installation of Electronic Flight Bag Components.
- AC 21-40, Guide for Obtaining a Supplemental Type Certificate.
- AC 23.1309-1, System Safety Analysis and Assessment for Part 23 Airplanes.
- AC 23.1311-1, Installation of Electronic Display in Part 23 Airplanes.
- AC 25-11, Electronic Flight Deck Displays.
- AC 25-16, Electrical Fault and Fire Prevention and Protection.
- AC 25.1523-1, Minimum Flightcrew.
- AC 25.1581-1, Airplane Flight Manual.
- AC 91-78, Use of Class 1 or Class 2 Electronic Flight Bag (EFB).
- AC 91.21-1, Use of Portable Electronic Devices Aboard Aircraft.
- AC 120-64, Operational Use & Modification of Electronic Checklists.
- AC 120-71, Standard Operating Procedures for Flight Deck Crewmembers.

2. FAA ORDERS, POLICY STATEMENTS (PS), AND TECHNICAL STANDARD ORDERS (TSO) (current editions). You can find orders, policy statements, and TSOs on the MyFAA employee Web site at https://employees.faa.gov. Inspectors can access orders and notices through the Flight Standards Information Management System (FSIMS) at http://fsims.avs.faa.gov. Operators and the public may find this information at http://www.faa.gov/regulations_policies/orders_notices.

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

3. INDUSTRY DOCUMENTS (current editions).

- RTCA/DO-160, Environmental Conditions and Test Procedures for Airborne Equipment.
- RTCA, Software Considerations in Airborne Systems and Equipment Certification.
- RTCA/DO-199, Potential Interference to Aircraft Electronic Equipment From Devices Carried Aboard.
- RTCA/DO-200, Standards for Processing Aeronautical Data.
- RTCA/DO-201, Standards for Aeronautical Information.
- RTCA/DO-208, Minimum Operational Performance Standards for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS).
- RTCA/DO-233, Portable Electronic Devices Carried Onboard Aircraft.
- RTCA/DO-242, Minimum Aviation System Performance Standards for Automatic Dependent Surveillance Broadcast (ADS-B).
- RTCA/DO-249, Development and Implementation Planning Guide for Automatic Dependent Surveillance Broadcast (ADS-B) Applications.
- RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware.
- RTCA/DO-255, Requirements Specification for Avionics Computer Resource (ACR).
- RTCA/DO-257, Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps.
- RTCA, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B).
- RTCA/DO-264, Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications.
- RTCA/DO-267, Minimum Aviation System Performance Standards (MASPS) for Flight Information Service-Broadcast (FIS-B) Data Link.
- RTCA/DO-272, User Requirements for Aerodrome Mapping Information.
- RTCA/DO-276, User Requirements for Terrain and Obstacle Data.
- RTCA/DO-282, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast.
- RTCA/DO-294, Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDs) on Aircraft.
- RTCA/DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems.
- ARINC 424, Navigation System Data Base.
- ARINC 653, Avionics Application Software Standard Interface.

- ARINC 653P1-3, Avionics Application Software Interface, Part 1, Required Services.
- ARINC 653P2-1, Avionics Application Software Standard Interface, Part 2 - Extended Services.
- ARINC 653P3, Avionics Application Software Standard Interface, Part 3, Conformity Test Specification.
- ARINC 660, CNS/ATM Avionics, Functional Allocation and Recommended Architectures.
- ARINC 661-4, Cockpit Display System Interfaces to User System.
- ARINC 828-3, Electronic Flight Bag (EFB) Standard Interface.
- ARINC 834-2, Aircraft Data Interface Function (ADIF).
- ARINC 840-1, Electronic Flight Bag (EFB) Application Control Interface (ACI) Standard.
- Aerospace Recommended Practice (ARP) 4754A, Guidelines for Development of Civil Aircraft and Systems.
- ARP4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.
- ARP5289A, Electronic Aeronautical Symbols.
- ARP5621, Electronic Display of Aeronautical Information (Charts).
- UN ST/SG/AC.10/11/Rev.5, Recommendations on the Transport of Dangerous Goods-Manual of Tests and Criteria.
- UN ST/SG/AC.10/34/Add.2, Amendments to the Fourth Revised Edition of the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria.
- National Institute of Standards and Technology (NIST) Special Publication 800-30, Risk Management Guide for Information Technology Systems.

4. ADDITIONAL GUIDANCE.

- Human Factors Considerations in the Design and Evaluation of Electronic Flight Bags (EFBs), Version 2: Basic Functions, Chandra, Divya C., Mangold, Susan J., Riley, Vic, and Yeh, Michelle, DOT-VNTSC-FAA-03-07, September 2003.
- FAA and Industry Guide to Product Certification, September 2004.
- Human Factors for Flight Deck Certification Personnel, Final Report DOT/FAA/RD-93/5, July 1993. Available at: http://www.hf.faa.gov/HFPortalNew/Search/DOCs/DOT-VNTSC-FAA-93-4.pdf.