



# Advisory Circular

## AC91-20

Revision 1

### Guidelines for the Approval and Use of Electronic Flight Bag Devices

17 September 2021

#### General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **Acceptable Means of Compliance (AMC)** with the associated rule.

Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate AC.

#### Purpose

This AC describes an acceptable means of compliance with standards for the approval and use of both portable and installed Electronic Flight Bag (EFB) devices in aircraft.

#### Related Rules

This AC relates specifically to parts in rules 121, 125 and 135 listed in Section 4 on page 5 of this document.

#### Change Notice

This is the first revision of AC91-20. It completely updates section 7, *Background*, and section 8, *Evaluation of Portable Hardware Components*. It also updates section 9.2, *Type B Software Applications*, and updates section 12.13, *Training*. Lastly, it renames and deletes duplicate sections, with the effect that section 10 in the first version is now section 8, section 11 has been largely deleted and what was section 13 in the previous version is now section 12.

Note that Section 12 to 12.12 is largely unchanged – while this revision focuses on technological change, a review of operational approval processes may be the focus of the next revision.

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## Version History

AC Revision No	Effective Date	Summary of changes
AC91-20 Rev 0	30 January 2012	The initial issue of this AC
AC91-20 Rev 1	17 September 2021	<p>The main changes include:</p> <ul style="list-style-type: none"><li>• complete update of section 7, Background, and section 8, Evaluation of Portable Hardware Components</li><li>• update of section 9.2, Type B Software Applications</li><li>• update of section 12.13, Training, and</li><li>• renumbering and deleting duplicate sections, with the effect that section 10 in Revision 0 is now section 8, section 11 has been largely deleted and what was section 13 is now section 12.</li></ul> <p>Following publication, some missing information was discovered. This was added on 8 November 2021, and comprised:</p> <ul style="list-style-type: none"><li>• clarification of the scope to include flight attendants</li><li>• added definitions and documents in the References and Definitions &amp; Abbreviations sections, and</li><li>• a new section 7.2.4, Cabin Electronic Flight Bags.</li></ul>

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## 1. Introduction

Until recently, aircraft have been required to carry a number of documents on board, particularly when operating under Instrument Flight Rules (IFR) or under the authority of an air operator certificate under Rule Part 119. Many of these paper documents were carried by crew in their flight bags; the move to greater use of documentation in electronic format has resulted in these documents being carried and displayed in aircraft on computer-based systems, commonly referred to as Electronic Flight Bags (EFB). The need for document configuration control and operating disciplines has not changed, but there are requirements for the installation, carriage and management of devices used as EFBs in order to maintain an equivalent level of operational safety.

## 2. Scope

This AC provides guidance to assist operators, flight crews and flight attendants in transitioning from the paper products in a traditional flight bag to an electronic format. This AC provides specific guidance material for certain EFB applications, and establishes guidance for operational use of EFBs and C-EFBs by crew members. Use this AC in combination with other material contained in current Communication, Navigation, and Surveillance (CNS) ACs or other relevant guidance material. This AC does not supersede existing operational guidance material.

## 3. Applicability

This AC is applicable to all air operators using or intending to use EFB equipment in aircraft. Any device, irrespective of ownership, is considered to be an EFB and subject to the provisions of this AC if the device is referenced for the operation of an aircraft either in preparation for flight or during flight.

If a privately owned electronic device is used as a portable EFB on an aircraft, the aircraft operator is responsible for ensuring the configuration management, content and use of the device(s) is in accordance with the operator's procedures and that the device and its installation in the aircraft meets the installation criteria of this AC.

## 4. Related Rules

The rules relating to the use of EFBs are listed below. Each of these rules has a requirement for documentation that could be met through the use of an EFB.

- **91.111 Documents to be carried:** Defines the documents that must be carried in aircraft; these documents must be carried in the aircraft except where there is an authorisation for an equivalent document acceptable to the Director.
- **91.221 Flying equipment and operating information:** Requires a pilot in command of an aircraft to ensure that certain equipment and information, in current and appropriate form, is accessible to every flight crew member of the aircraft. For instance, appropriate aeronautical charts, for IFR operations, every appropriate navigational *en route*, terminal area, approach, and instrument approach and departure chart.
- **119.65 Airline Air Operator – Documentation & 119.151 Continued compliance:** Requires a holder of an airline air operator certificate to establish a procedure for the control of applicable documentation and ensure that relevant documents are available to personnel at all locations where access is needed to documentation, either in hard copy or electronic, or other form acceptable to the Director.

- **119.113 General Aviation Air Operator – Documentation & 119.115 Continued compliance:** Similar to rule 119.65
- **121.59 Flight preparation:** Requires holder of an air operator certificate to ensure that for each air operation, appropriate information is available to the pilot-in-command to complete preparation for the operation.
- **121.77 Flight check system:** Requires holder of an air operator certificate to ensure that flight crew members have available for use a flight check system that includes instructions and guidelines for the safe and efficient management of the flight deck and methods used to conduct the flight safely.
- **125.57 Flight preparation:** Similar to rule 121.59
- **125.63 Flight check system:** Similar to rule 121.77
- **135.57 Flight preparation and flight planning:** Similar to rule 125.57
- **135.63 Cockpit check:** Requires holder of an air operator certificate to ensure that flight crew members have available for use a cockpit checklist covering procedures, including emergency procedures, for the operation.

In each of the above rules, there are requirements for documentation; some of the documentation is required to be carried on the aircraft, but there are other documents commonly carried to make the information readily available to personnel as required by Part 119.

- **121.305 Aeroplane load limitation:** Requires holder of air operator certificate to ensure that limitations contained in the aeroplane flight manual or approved document relating to weight and balance of aeroplane, maximum allowable weights, and centre of gravity are complied with.
- **121.307 Load manifest:** Requires holder of air operator certificate to ensure that the load manifest meets requirements specified in the rule.
- **125.305 Aeroplane load limitation:** Similar to rule 121.305
- **125.307 Load manifest:** Similar to rule 121.307
- **135.303 Aircraft load limitations:** Similar to rule 125.305

The rules immediately above all relate to aircraft loading, weight and balance, and aircraft limits. Within an EFB, associated information can be electronic documents that are copies of existing paper documents or something with a computational capability like an app or other tool. In either case, compliance with the rules and operating limitations must be maintained. If the EFB has a computational or look-up function, the function must be validated to ensure that the correct results are obtained and are equivalent to using the relevant conventional paper or electronic documents.

## 5. References

The following documents are referenced in this AC:

### Civil Aviation Authority

AC00-6 Electronic Signatures, Electronic Record keeping and Electronic Manuals

AC91-5 Operation of Portable Electronic Devices (PEDs) During Flight Under IFR

**Federal Aviation Administration:**

AC 20-175 Controls for Flight Deck Systems

AC 20-173 Installation of Electronic Flight Bag Components

AC 91-78 Use of Class 1 or 2 Electronic Flight Bag (EFB)<sup>1</sup>

AC 120-76D Authorization for Use of Electronic Flight Bags

ANM-01-111-165, Power Supply Systems for Portable Electronic Devices

TSO C165 Electronic Map Display Equipment for Graphical Depiction of Aircraft Position

**European Aviation Safety Agency:**

AMC 20-25 Airworthiness and operational consideration for Electronic Flight Bags (EFBs)

**International Civil Aviation Organization**

Doc 10111 Manual on the Implementation and Use of Cabin Electronic Flight Bags

## 6. Definitions & Abbreviations

### 6.1 Definitions

For the purposes of this AC, the following terms are defined:

**Aircraft Administrative Communications** is a data link to receive/transmit information that includes, but is not limited to, the support of applications identified in Appendices A and B.

**Cabin Electronic Flight Bag (C-EFB)** means an electronic information system, comprised of equipment and applications for cabin crew, which allows for storing, updating, displaying and processing of C-EFB functions to support flight and cabin operations or duties.

**Data Connectivity for EFB Systems** provide information interconnections that support functions for which failures or design errors could not degrade aircraft systems or flight crew performance.

**Electronic Flight Bag (EFB)** means an electronic display system intended primarily for cockpit/flight-deck or cabin use which can display a variety of aviation data or perform basic calculations and is used by a flight crew member during a flight

**EFB System** includes the hardware and software needed to support EFB functions.

**Hosted Application** means software installed and running on an EFB system that is not considered to be part of the aircraft type design.

**Installed EFB** includes equipment components supporting EFB applications that are incorporated into aircraft type design or are fitted using acceptable technical data.

**Mounting Device** includes arm-mounted, kneeboard, cradle, clips or docking-stations.

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<sup>1</sup> Note that this FAA AC still uses the old Class 1 and Class 2 nomenclature.

**Portable EFB** all other equipment components supporting EFB applications that are not installed, regardless of how often they are removed from the aircraft. This includes what were formerly called Class 1 and 2 EFBs.

**Portable Electronic Device (PED).** These devices are typically consumer commercial off-the-shelf electronic devices functionally capable of communications, data processing, and/or utility.

## 6.2 Abbreviations

For the purposes of this AC, the following abbreviations are defined:

AAC Aircraft Administrative Communications

AFM Aircraft Flight Manual

AFMS Aircraft Flight Manual Supplement

C-EFB Cabin Electronic Flight Bag

COTS Commercial Off the Shelf

EFB Electronic Flight Bag

FITS FAA / Industry Training Standards

IFR Instrument Flight Rules

IR Instrument Ratings

PED Portable Electronic Device

PIC Pilot in Command

TSO A technical standard order issued by the FAA

VFR Visual Flight Rules

## 7. Background

### 7.1 What is an EFB?

a. An EFB is any device, or combination of devices, actively displaying EFB applications. EFBs are characterised by the following elements:

- An EFB hosts applications, which are generally replacing conventional paper products and tools, traditionally carried in the pilot's flight bag. EFB applications include natural extensions of traditional flight bag contents, such as replacing paper copies of maps.
- In order to qualify as an EFB application, the failure effect must be considered a minor hazard or have no safety effect.
- Acceptable EFB applications are listed in Appendices A and B. These EFB applications may be overlaid or integrated.
- EFBs cannot replace any installed equipment required by operational or airworthiness regulations.

- EFB applications have no certification requirements for installation under aircraft type design (refer to the FAA's AC 20-173).

## 7.2 EFB Application Types

- a. EFB applications are categorised as Type A or B and can be hosted on either portable or installed components.

### 7.2.1 Type A Applications

- Are listed in Appendix A
- Have a failure condition classification considered to be no safety effect
- Do not substitute for or replace any paper, system, or equipment required by airworthiness or operational regulations, and
- Do not require specific authorisation for use (i.e., although the Type A EFB application is part of the operator's EFB program, Type A EFB applications are not identified or controlled in the Operational Specifications).

### 7.2.2 Type B Applications

- Are listed in Appendix B
- Have a failure condition classification considered Minor
- May substitute or replace paper products of information required for dispatch or to be carried in the aircraft
- May not substitute for or replace any installed equipment required by airworthiness or operating regulations, and
- Require specific authorisation for operational authorization for use (i.e., each Type B EFB application must be authorised by CAA in the Operational Specifications).

### 7.2.3 Hardware Supporting EFB Applications

- a. In the context of this AC, EFB equipment components supporting EFB applications are "installed" when they are incorporated into aircraft type design or are fitted using acceptable technical data. All other components supporting EFB functionality are considered "portable," regardless of how infrequently they are removed from the aircraft.
- b. In order for portable EFB hardware to support EFB applications, installation of at least some EFB components may be needed, depending on requirements for positional integrity (e.g., installed mounts), continuity of power (e.g., dedicated primary power port), and data connectivity (e.g., Wireless Fidelity (Wi-Fi®)), and Ethernet). Airworthiness regulations 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), data connectivity (input/output (I/O)), and data specifications and security. In these situations, acceptable technical data is required in accordance with rule **21.503**.

- c. In addition, portable EFBs are considered PEDs and must comply with requirements in rule 91.7. Those requirements address the carriage and use of PEDs in aircraft operating under IFR. Aircraft operated under visual flight rules (VFR) in accordance with Part 91 are not subject to rule 91.7. However, the pilot-in-command must still ensure the operation of the EFB does not adversely affect the safe operation of the aircraft.

### **7.2.4 Cabin Electronic Flight Bags (C-EFBs)**

- a. An EFB developed for cabin operations is referred to as a C-EFB. The components of a C-EFB include, but are not limited to, cabin crew operations manuals, checklists, forms, passenger information, and tools for real-time reporting.
- b. The Director needs to approve the introduction and use of C-EFBs for the cabins of operations performed under Parts 121 and 125. Part of the process for gaining operating approval would include CAA evaluating all operating procedures, pertinent training modules, checklists, operations manuals, training manuals, any other relevant documents, and reporting procedures.
- c. There is more information on C-EFBs and special considerations pertaining to their use in ICAO Doc 10111, *Manual on the Implementation and Use of Cabin Electronic Flight Bags*.

## **8. Evaluation of Portable Hardware Components**

### **8.1 Paper Data Removal**

- a. At least two (2) portable functional EFBs must be carried on the aircraft, and readily accessible to the flight crew during flight to remove paper products that contain aeronautical charts, checklists, or other data required by the operating rules. The design of the system architecture requires that no single failure, or common mode error, may cause the loss of required aeronautical information.

### **8.2 EFB Stowage**

- a. Stowage requires an inherent means to prevent unwanted EFB movement. EFB stowage is required for all portable EFBs not secured in or on a mounting device. If an EFB mounting device is not provided (via viewable stowage or installed mounts), then it is necessary to:
- designate an area to securely stow the EFB, and
  - do this in a manner to prevent the device from jamming flight controls, damaging flight deck equipment, or injuring flight crew members should the device move about because of turbulence, manoeuvring, or other action.
- b. The stowage area must not obstruct visual or physical access to controls and/or displays, flight crew member ingress or egress, or external vision. An acceptable stowage location for a portable EFB with no mount includes the inside compartments of the pilot's stowed flight bag.

### **8.3 EFB Mounting Devices**

- a. **Design of Mounting Device.** Position the EFB mounting device (or other securing mechanism) in a way that does not obstruct visual or physical access to aircraft controls and / or displays, flight crew ingress or egress, or external vision. The design of the mount should allow the user

easy access to the EFB controls and a clear view of the EFB display while in use. The following design requirements should be considered as a minimum:

- i. The mount and associated mechanism should not impede the flight crew in the performance of any task (normal, abnormal, or emergency) associated with operating any aircraft system.
  - ii. Mounting devices should be able to lock in position easily. Selection of positions should be adjustable enough to accommodate a range of flight crew member preferences. In addition, the range of available movement should accommodate the expected range of users' physical abilities (i.e. anthropometric constraints). Locking mechanisms should be of the low-wear type that will minimise slippage after extended periods of normal use. Crashworthiness considerations will need to be considered in the design of this device. This includes the appropriate restraint of any device when in use.
  - iii. A method should be provided to secure, lock, or stow the mount in a position out of the way of flight crew member operations when not in use.
  - iv. If the EFB requires cabling to mate with aircraft systems or other EFBs, and if the cable is not run inside the mount, the cable should not hang loosely in a way that compromises task performance and safety. Flight crew members should be able to easily secure the cables out of the way during aircraft operations (e.g. cable tether straps).
  - v. Cables that are external to the mount should be of sufficient length to perform the intended tasks. Cables that are too long or too short could present an operational or safety hazard.
- b. **Placement of Mounting Device.** When the EFB is in use and is being viewed or controlled, it should be easily accessible and within 90 degrees on either side of each pilot's forward line of sight. If using an EFB to display flight-critical information such as for navigation, terrain, and obstacle warnings that require immediate action, take-off and landing V-speeds, or for functions other than Situational Awareness (SA), then such information needs to be in the pilot's primary field of view (FOV). This requirement does not apply if the information is not being directly monitored from the EFB during flight. For example, an EFB may generate take-off and landing V-speeds, but these speeds are used to set speed bugs or are entered into the FMS, and the airspeed indicator is the sole reference for the V-speeds. In this case, the EFB need not be in the pilot's primary FOV. A 90-degree viewing angle may be unacceptable for certain EFB applications if aspects of the display quality are degraded at large viewing angles (e.g. the display colours wash out or the displayed colour contrast is not discernible at the installation viewing angle).
- c. **Mounting EFB Equipment.** An unsafe condition may be inadvertently created when attaching any EFB control yoke attachment / mechanism or mounting device. For example, the weight of the EFB and mounting bracket combination may affect flight control system dynamics, even though the mount alone may be light enough to be insignificant. The mount must be installed in accordance with applicable airworthiness regulations. Design approval for a yoke-mounted EFB must specify the size, shape, weight, and attachment means of any portable device mounted on the flight control yoke. EFB equipment, when mounted and/or installed, should not present a safety-related risk or associated hazard to any flight crew member. There must be a safe way to store or secure the device when not in use. Additionally, the unit (or its mounting structure) should not present a physical hazard in the event of a hard landing, crash landing, or water ditching. EFBs and their power cords should not impede emergency egress.

## 8.4 Electrical Power Source.

- a. EFB 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. For recharging, the operator must establish a procedure to ensure safe recharge of the battery. EFBs that do not have battery backup, and that are used to remove paper products required by the operating rules, are required to have at least one EFB connected to an aircraft power bus.
- b. Portable EFB electrical power source provisions that are certified on Part 25<sup>2</sup> aircraft are required to follow the policy outlined in the Transport Airplane Directorate policy statement, *ANM-01-111-165, Power Supply Systems for Portable Electronic Devices*, unless an alternative method is proposed by the operator and approved by the Director.

### 8.4.1 Battery Backup

- a. Some applications, especially when used as a source of required information, may require that the EFB use an alternate power supply to achieve an acceptable level of safety. The operator is also responsible for ensuring the replacing of batteries is done as required, but no less often than the EFB manufacturer's recommended interval.

### 8.4.2 Battery Replacement

- a. 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.

### 8.4.3 Lithium Batteries

- a. Rechargeable lithium-type batteries are becoming more common as a standby or backup power source used in EFBs. The users of rechargeable lithium-type batteries in other industries, ranging from wireless telephone manufacturers to the electric vehicle industry, have noted safety concerns. These concerns are primarily the result of overcharging, over-discharging, and the flammability of cell components. Lithium-ion or lithium-polymer (lithium-ion polymer) batteries are two types of rechargeable lithium batteries commonly used to power EFBs. These types of batteries are capable of ignition and subsequent explosion due to the flammability of cell components. They are also 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 and toxic smoke. 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. The word "battery" used in this AC refers to the battery pack, its cells, and its circuitry.
- b. The rechargeable lithium-type battery design should be compliant with the provisions of Institute of Electrical and Electronic Engineers (IEEE) 1625, *IEEE Standard for Rechargeable Batteries for Portable Computing*. This standard contains design considerations for system integration, cell, pack, host device, and total system reliability. It also covers how to maintain

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<sup>2</sup> Refer to CAA Rules Part 21, Appendix C, (a) (1) (ii) for applicable FAA Regulations

- critical operational parameters with respect to time, environment, extremes in temperature, and the management of component failure.
- e. There may also be other regulations that apply to the carriage and use of lithium batteries on-board aircraft.

#### **8.4.3.1 Lithium Battery Cautions**

- a. Due to their proximity to the flight crew and potential hazard to safe operation of the aircraft, the use of rechargeable lithium-type batteries in EFBs located in the aircraft cockpit need to meet the following standards:
- b. **Safety and Testing Standards.** Operators should test EFB batteries and recharging systems to ensure safety and reliability. Operators must use one of the following safety and testing standards as a minimum for determining whether rechargeable lithium-type batteries used to power EFBs are acceptable for use and for recharging:
- i. **Underwriters Laboratories (UL).** UL 1642, Lithium Batteries; UL 2054, Household and Commercial Batteries; and UL 60950-1, Information Technology Equipment - Safety
  - ii. **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
  - iii. **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*, Fifth revised edition, or
  - iv. **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.
- c. **Showing Compliance.** The operator provides CAA with records of compliance to these battery standards during the AUTHORISATION to use the EFB. These records may be available from the battery's Original Equipment Manufacturer (OEM).

#### **8.4.3.2 Rechargeable Lithium-Type Battery Maintenance, Storage, and Functional Check**

- a. Operators should have documented maintenance procedures for their rechargeable lithium-type batteries. These procedures should:
- meet or exceed the OEM's recommendations
  - address battery life, proper storage and handling, and safety
  - include 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, and

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

#### **8.4.4 Use of Aircraft Electrical Power Sources**

- a. Aircraft electrical power outlets are part of the type design of the aircraft and require airworthiness certification. Appropriate labels should identify the electrical characteristics (e.g. 28VDC, 115VAC, 60 or 400 Hz, etc.) of electrical outlets.
- b. Rechargeable lithium-type batteries pose a much higher safety hazard when recharging than other battery chemistries. The aircraft electrical power provisions for recharging lithium-type batteries in the aircraft cockpit should address battery sensitivity to voltage and current parameters. Do not connect to the electrical outlet if the connection label does not exactly match the power requirements, both voltage and amperage, of the lithium batteries' charging system.
- c. 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. There is a requirement for a certified means (other than a circuit breaker) installed in accordance with applicable airworthiness regulations for the flight crew to de-power the EFB power source or system charger. Additional actions and application of airworthiness regulations are not applicable to the internal elements of portable EFBs unless specified in this AC.

### **8.5 Environmental Hazards Identification and Qualification Testing**

#### **8.5.1 Portable EFB Electromagnetic Compatibility (EMC) Demonstration**

- a. It is the user's/operator's responsibility to determine that all portable EFB components, including cords/cables for data or power, will not interfere, in any way, with the operation of aircraft equipment. Note that AC91-5, Operation of portable electronic devices (PED) during flight under IFR, addresses non-interference testing for non-critical phases of flight only and is not adequate when Type B applications can be used during all phases of flight. The following methods, 1 and 2 below, are applicable to portable EFBs with Type B applications required for use during all phases of flight. The user/ operator may use either Method 1 or Method 2 for non-interference testing.
- b. The two following steps complete Method 1 for compliance with PED non-interference testing for all phases of flight:
  - i. Step 1 is to conduct an electromagnetic interference (EMI) test in accordance with RTCA/DO-160, Section 21, Category M. An evaluation of the results of the RTCA DO-160 EMI test can be used to determine if there is an adequate margin between the EMI emitted by the PED and the interference susceptibility threshold of aircraft equipment. If Step 1 testing determines 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.

- ii. 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.
- c. Method 2 for compliance with PED non-interference testing for all phases of flight is a complete test in each aircraft using a suitable checklist. This checklist should be of the extent normally considered acceptable for non-interference testing of a PED in an aircraft for all phases of flight. Credit may be given to other similarly equipped aircraft of the same make and model as the one tested.

### **8.5.2 EFBs With Transmitting Functions.**

- a. An EFB with a transmitting function can only use that function when the aircraft is on the ground or is operating under VFR. If an operator intends to use the transmitting function of an EFB in flight, an EMC test must be carried out as part of the authorisation process to ensure that there will be no interference to the aircraft or its systems. Rule 91.7 (a) prohibits the use of any PED with a transmitting function when the aircraft is operating IFR. An EFB with a transmitting function may be used in flight provided that the transmitting function was inhibited (turned off) prior to take-off.

### **8.5.3 Rapid Depressurisation Testing**

- a. **Environmental Tests.** Other environmental testing, specifically testing for rapid depressurisation, may be needed. However, since many portable EFBs were originally COTS electronics adopted for aviation use, testing done on a specific EFB model configuration may be applied to other aircraft and these rapid decompression tests need not be duplicated. It is the responsibility of the operator to provide documentation that these tests have been accomplished on a representative sample of the EFB. 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 using Type B software applications in pressurised aircraft, unless alternate procedures or 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 pressurised aircraft. 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 explain why an EFB is sufficiently similar to a unit already tested.
  - i. **Pressurised Aircraft.** Rapid decompression testing needs to be conducted for portable EFB devices when the EFB has Type B applications and is used to remove paper-based aeronautical charts in a pressurised aircraft in flight. When a portable EFB demonstrates rapid decompression while turned on and remains reliably operating during the rapid decompression test, then no mitigating procedures need be developed beyond dual redundancy. If a portable 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 on-board the

aircraft remains off or configured so that no damage will be incurred should rapid decompression occur in flight above 10,000 feet mean sea level (MSL).

- ii. **Un-Pressurised Aircraft.** Rapid decompression testing is not required for a portable EFB used in an un-pressurised aircraft. However, 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.

## 8.6 Data Connectivity with Aircraft Systems (Wired or Wireless)

- a. This section applies to both portable and installed EFBs. Typically, installed EFBs will have an interface protection built into the installed EFB, while portable EFBs will have a separate data connectivity provision installed in the aircraft. All EFBs using data connectivity provisions to aircraft systems must incorporate an interface protection device (e.g. physical partitioning or read-only access) to ensure that the data connection required by the device, and its software applications, have no adverse effects on other aircraft systems. EFBs which have data connectivity to aircraft systems, either wired or wireless, may read or transmit data to and from aircraft systems, provided the connection and interface protection device is defined as part of the aircraft type design. This connectivity includes data bus and communication systems access (e.g. through an avionics data bus, server, network interface device, or wireless network). Use the following guidance for read-only and transmit-receive data interface protection devices:
- b. **Read-Only Access.** The design of interface protection devices that provide read-only access must ensure protection by using one-way communication of data.
- c. **Transmit-Receive Access.** The design of interface protection devices that provide transmit (talk) and receive (read) capability must include:
- i. **Partition.** The design must provide a means of partition for applications that have not been approved from installed systems on the aircraft.
  - ii. **Non-Interference.** The design must include a means to ensure that EFB operation, malfunction, or failure does not adversely affect other installed aircraft systems to which a connection is made (i.e. non-essential, essential, and critical).
  - iii. **Security Considerations.** The design of interface protection devices enabling connection of EFBs to existing aircraft equipment, systems, data buses, or networks must not introduce potential security vulnerabilities and threats in terms of computer viruses, worms, unauthorised access, and malicious access. It will be crucial to:
    - design the data interface protection device to prevent any potential security threats, and
    - provide plans for verifying and maintaining the security protection mechanisms and functionality to adequately address each threat.

## 9. Software Applications for EFBs

The functionality associated with the EFB system depends upon the applications loaded on the host. As previously stated, those applications are classified into 2 Types (A and B) to provide clear divisions between the scope and, therefore, the approval process applied to each one. Although

guidelines and examples are provided in this AC to provide guidance as to the Type associated with a particular application, there is still the potential for misclassification.

Applicants should be aware of two particular issues. The Type of software application will influence the level of participation of CAA and the involvement or otherwise of airworthiness authorities in the assessment exercise. For example, a misclassification may later be shown to have impacted the underlying airworthiness approval granted for the aircraft systems. In particular, where there is data connectivity or interactive information the assumptions made by the OEM-during initial certification may no longer hold e.g. data integrity, accuracy of performance calculations, primary use versus situational use. Therefore, if there is any doubt as to the classification of an application, applicants should seek advice from CAA early on in the approval process.

## **9.1 Type A Software Applications**

Appendix 1 lists examples of EFB hosted software applications. Type A software applications include pre-composed, fixed presentations of data currently presented in paper format. Type A applications can be used on the ground or during noncritical phases of flight. Malfunction of a Type A application is limited to a hazard level defined as no greater than a minor failure condition classification for all flight phases and one which has no adverse effect on the safety of a flight operation. The operator must possess evidence demonstrating that the operational and certification requirements are met when using the applications listed in Appendix 1. Pertinent points are:

- a. Type A application software does not require compliance with RTCA/DO-178C.
- b. The operator can use the application after successful completion of the user/operator evaluation (including flight crew training, checking, and currency requirements).
- c. Type A application software for Weight and Balance (W&B) are applications that present existing information found in the applicable AFM or 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).
- d. 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).
- e. 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.
- f. The operator should provide evidence demonstrating that the EFB operating system and hosted application software meet the criteria for the appropriate 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.

## **9.2 Type B Software Applications**

Appendix 2 lists examples of EFB hosted software applications. Type B applications include dynamic, interactive applications that can manipulate data and presentation. Malfunction of a Type B application is limited to a hazard level defined as no greater than a minor failure condition classification for all flight phases and have no adverse effect on the completion of a flight operation. The operator must provide evidence demonstrating that the operational and certification requirements are met when using the applications listed in Appendix 2. Pertinent points are:

- a. Type B application software does not require compliance with RTCA/DO-178C or equivalent EASA standard, e.g. EC-12.
- b. The operator can use the application after successful completion of the user / operator evaluation (including flight crew training, checking, and currency requirements).
- c. Type B applications are used to display pre-composed or interactive information such as navigation or approach charts. Required flight information is presented for each applicable phase of flight. A map-centring or page-turning function can be authorised if the operator properly evaluates it. Electronic navigation charts must provide a level of information integrity equivalent to paper charts.

***NOTE: Special care must be taken for those applications that can display own-ship position. As these applications are not approved for navigation or otherwise, own-ship position can only be used for situational awareness. Own-ship position cannot be used for navigation purposes or as an Airport Moving Map Display unless approved by CAA.***

***For guidance on the display of own-ship position, see FAA Technical Standard Order (TSO)-C165, Electronic Map Display Equipment for Graphical Depiction of Aircraft Position (current edition).***

***For guidance on Airport Moving Map Displays, see FAA AC 20-159, Obtaining Design and Production Approval of Airport Moving Map Display Applications Intended for Electronic Flight Bag Systems.***

- d. Operators must determine the usage of hardware and/or software architectural features, persons, procedures, and or equipment to eliminate, reduce, or control risks associated with an identified failure in a system.
- e. The operator should provide evidence demonstrating that the EFB operating system and hosted application software meet the criteria for the appropriate intended function and do not provide false or hazardously misleading information. This evidence includes a demonstration that software revisions will not corrupt the data integrity or intended function of the original installed software configuration.
- f. Weather information applications in EFBs are supplemental to the information required by the applicable Civil Aviation Rules, notably Rule Parts 121, 125, 135, and do not supersede it. The primary source of meteorological information is the one supplied by a Part 174 holder or an aviation meteorological service organisation that meets the requirements of rules 121.153(a) (1) and (2); 125.153 (a) (1) and (2); and 135.153 (b) (1) and (2). Use of supplementary meteorological information is not prohibited and operators can use it as an additional source of information. However, participants need to check the rules for their type of aircraft, with regards to using Part 174 certificated or other suitable meteorological information. If other sources of weather information are permitted, these services should contribute only to increased SA and support the crew members when making strategic decisions. It should be for non-safety-critical functions only and not a function that is necessary for the performance of the flight. This means that:
  - they should not be used to support tactical decisions and/or substitute certified aircraft systems (e.g. weather radar), and
  - information from the official flight documentation or aircraft primary sources or systems should always prevail in case there is a contradiction with EFB weather information.

The meteorological information provided to the flight crew should be as far as possible consistent with what is available to ground-based aviation meteorological information users (e.g. airline Operations Centre, dispatcher, etc.), in order to establish common situation awareness and to facilitate collaborative decision-making.

Meteorological information obtained in-flight must come from a CAA Part 174 certified meteorological service provider, unless specifically allowable under the rule applicable to their aircraft. A list of Part 174 certificate holders is available in the AIP. Consideration should also be given to checking the currency or age of the information that is being provided. One method that the PIC may consider for the assurance of other reliable sources, if allowable, is to only use providers that have been certified for this purpose by an overseas regulator, and where a written assurance that sufficient coverage for the NZ FIR is provided to the operator.

For ease of reference, Australian Civil Aviation Safety Authority CASR Part 175 Providers can be found here:

<https://www.casa.gov.au/airspace/aeronautical-information-management/data-service-providers>

Note: - The rule parts under which the flight is conducted (Part 91, Part 135, Part 121 etc) have requirements on the type and integrity of the meteorological data used before and during the flight.

- g. Type B applications for W&B are software applications that have their basis on existing information found in the approved flight manual, POH, or W&B manual for an aircraft. Type B W&B applications use data management software to provide data reference and mathematical calculation to simplify calculation 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.
- h. Type B applications for performance are software applications based on existing information found in the approved flight manual, 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 existing AFM approved data and 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 data contained in the current approved AFM. These algorithms have to be tested and verified to meet existing approved AFM performance data. Type B performance applications must not extrapolate or project results not represented by AFM approved data points 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.
- i. Type B applications require a validation period, typically 6 months, 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.

- j. 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 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 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 the applications accurately adhere to and are limited to the AFM approved data envelope segments and for performance must represent net climb gradient with considerations including but not limited to level-off, acceleration, transitions, and engine take off 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 in so far as they accurately reproduce the paper AFM data. Type B W&B and/or performance applications must meet approval criteria listed in FAA Order 8900.1, Volume 4, Chapter 3, Section 3, Approval of Performance Data Sections of CFMs.
- k. Operators must develop operational procedures in accordance with rule part 121.133 for aircraft operated under this part. For Part 121 operators, EFB operating procedures must be developed and included in the operator's exposition. These procedures should define the roles that the flight crew and dispatch / flight following have in creating and reviewing performance calculations. Operational Specifications approvals must be issued as appropriate to the operator.

### **9.3 Approved Software Applications**

Approved applications are National Aviation Authority-approved software using RTCA/DO-178C compliance, or other acceptable means. Software approval guidelines are found in RTCA/DO-178C and the current edition of FAA Order 8110.49, *Software Approval Guidelines*.

- a. Approved applications for W&B and/or performance are those applications approved by a Regulatory Authority for a specific aircraft and are approved as part of the AFM or as an AFMS.
- b. CAA evaluated software applications will have a CAA approved flight manual supplement.
- c. Contact CAA for assistance regarding applications offered by aircraft manufacturers or Supplemental Type Certificate (STC) holders for specific aircraft. The operator may utilise approved W&B and/or performance applications on portable EFBs provided the software system requirements are met. Approved applications for W&B and/or performance are those applications approved or accepted by a National Aviation Authority for a specific aircraft. These approved W&B and/or performance software applications are approved as part of the AFM or as an AFM Supplement. CAA evaluated software applications will have a CAA approved flight manual supplement.
- d. Approved applications may be granted TSO approvals by some National Aviation Authorities. EFB approved applications that receive a TSO approval may be authorised for use on EFBs provided they meet the following conditions:

- i. Hosted applications must be classified as a Minor failure effect or no safety effect. No major safety effect or higher classifications are acceptable.
- ii. Type A and/or Type B EFB applications may reside in a TSO system provided they do not interfere with the EFB approved application(s).

## 10. EFB System Design Considerations

Refer to FAA's AC 120-76D for guidance on the design and development of an EFB.

## 11. Risk Mitigation for EFB Systems

During the transition period to a paperless cockpit, an operator will need to establish a reliable means of providing the information required by relevant rules to the flight crew. During this period, an EFB system must demonstrate that it produces records that are as available and reliable as those provided by the current paper information system. AC00-6, *Electronic Signatures, Electronic Record keeping and Electronic Manuals*, provides additional guidance. If an operator wants to transition to a paperless cockpit, an acceptable process needs to be developed in consultation with CAA. Mitigation may be accomplished by a combination of the following:

- a. System design
- b. Separate and backup power sources
- c. Redundant EFB applications hosted on different EFB platforms
- d. Paper products carried by selected crewmembers
- e. Complete set of sealed paper backups in cockpit, and/or
- f. Procedural means, that is procedures developed by the operator relating to cockpit or ground procedures, or both.

If one or more on-board 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:

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

Complete removal of the paper-based information associated with a particular EFB application, will require CAA approval for Type A, or Type B, and Operations Specification approval. These requirements also apply to an operator who intends to begin operation of any aircraft type without paper-based information.

Final approval for use of electronic documents, in lieu of required paper documents, requires:

- a. a risk mitigation report being submitted to CAA
- b. reliable EFB system information being available for each flight crew member
- c. a final CAA evaluation report, and

- d. Operations Specification approval.

## 12. Operational Approval Process

The introduction and use of EFBs in the cockpit and cabin of operations performed under Rule Parts 121, 125 or 135 requires operational approval from the Director. This requirement includes CAA evaluation of all operating procedures, pertinent training modules, checklists, operations manuals, training manuals, maintenance programmes, MELs, other pertinent documents, and reporting procedures.

### 12.1 Part 91 Operations

Part 91 operations do not require any specific authorisation for EFB operations, provided the EFB does not replace any system or equipment required by the rules. This AC provides guidance for all EFB equipages of all hardware classes and software types. For a PED to be considered an EFB, its functions must conform to the guidance in this AC.

### 12.2 General Process for Approval or Acceptance

The operational approval of EFBs consists of the following five phases:

- a. Phase 1 of the process begins when an operator requests an operational approval from the Director by completing CAA Form 24091/09 available from the “Forms” link on the CAA web site [www.caa.govt.nz](http://www.caa.govt.nz). CAA and the operator should reach a common understanding of what the operator must do, what role CAA will have, and what reports and documents will be included as part of the authorisation process.
- b. Phase 2 begins when the operator submits an operational approval plan to CAA for formal evaluation. During this phase, CAA must ensure that the plan is complete and in an acceptable format before it can conduct a thorough review and analysis. The operator must identify the equipment to be used as an EFB, the type of software applications to be used, details of any mounting or stowage provisions and any other interfaces to the aircraft such as power supplies or data connections. The operator coordinates the plan with the CAA operational group responsible for their oversight. The operating group will facilitate coordination within CAA, as necessary.
- c. Phase 3 begins when CAA starts its in-depth review and analysis of the operator’s plan for regulatory compliance, safe operating procedures, a logical sequence, and other areas (e.g. flight crew and dispatcher qualifications, acceptable procedures, and schedules for accomplishment).
- d. 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 CAA observation purposes. Phase 4 concludes when the operator provides sufficient proof to satisfy CAA’s requirement for meeting all the plan objectives or when the operator is unable to complete them satisfactorily.
- e. Phase 5 begins after the successful completion (or termination) of the validation phase. In this phase, CAA grants authorisation for those elements in the plan that were successfully completed and documented in the Operational Review report, or sends the operator a letter of disapproval for those elements that were not completed or were terminated. The Director grants authorisation for the operational use of the EFB through the issuance of revised Operational Specifications.

## 12.3 Operator Responsibilities

In addition to close coordination with CAA to obtain operational approval for EFB use, the following steps (in chronological order) are suggested:

- a. Apply to the Director in writing.
- b. Demonstrate a process of ensuring initial and continuing reliability for each specific EFB unit.
- c. Demonstrate that the radio magnetic interference/electromagnetic interference tests have been performed satisfactorily.
- d. Demonstrate that the EFBs can be properly stowed, secured and/or mounted in the aircraft.
- e. Demonstrate that any electronic receptacles used for connection of the EFB to an aircraft system have been installed using technical data acceptable to the Director as listed in Rule Part 21 Appendix D.
- f. Demonstrate successful rapid decompression testing has been accomplished, if applicable.
- g. Develop a Policy and Procedures Manual (PPM) that may include, but is not limited to, the following:
  - For single-pilot- and multi-crew-flown aircraft, appropriate procedures for EFB use during all phases of flight
  - Procedures to follow when one unit fails (where multiple units are carried on-board the aircraft)
  - Procedures to follow when all units fail (the procedures should specifically identify the alternate means to use to obtain 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, etc.)
  - A list of the data loaded and maintained in each unit, and
  - Instructions for Continued Airworthiness in accordance with the manufacturer's recommendations (also include these instructions in the inspection/maintenance programme).
- h. Operators transitioning to a paperless cockpit should carry paper backups of all the information on the EFB during a validation period. The backup 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. This validation period should include a 6-month operational test evaluation where the EFB system(s) with all appropriate backup products will be available to the crew. The backup products and the EFB are not used simultaneously during the evaluation period, but the backup products are available if needed. The operator will issue a final report detailing the training effectiveness, operational effectiveness, and reliability of the EFB.

## 12.4 Operational Procedures Development

- a. **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.
- b. **Operator Responsibilities.** Operators are expected to:
  - i. have procedures that define expectations of how the flight crew should use each EFB function during ground operations and under all flight conditions
  - ii. provide the procedures to flight crews
  - iii. provide procedures for normal, abnormal, and emergency use, and
  - iv. review and determine whether to modify those existing policies and procedures affected by the introduction of EFBs into line operations.

## 12.5 Procedural Considerations.

- a. **Procedures for Using EFBs with Other Flight Deck Systems.** Flight crew procedures will ensure that the flight crew knows what aircraft system to use for a given purpose, especially when both the aircraft and EFB are providing 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 existing cockpit automation displays, procedures to identify which information source will be primary and which source will be secondary need to be developed (and procedures to identify under what conditions to use the backup source). Whenever possible and without compromising innovation in design/use, EFB/user interfaces should be consistent (but not necessarily identical) with the flight deck design philosophy.
- b. **Flight Crew Awareness of EFB Software/Database Revisions.** The operator should have a procedure in place to allow flight crew members 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 flight crews.) An example of a date-sensitive revision is an aeronautical chart database on a 28-day AIRAC revision cycle. Procedures should specify what action to take if the applications or databases loaded on the 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 flight crew 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 flight crew shutdown checklist procedures, and
  - allow the EFB operating system and hosted applications to remain “stable” after multiple start-ups and shutdowns.

## 12.6 EFB Configuration Control

The operator's EFB specification documents must list the make and model of the authorised EFB equipment and include at least the following configuration information, which is also required to support Operations Specification approval:

- a. operating system to include version control
- b. application programme version control
- c. approved source for the database updates, and
- d. make and model of the EFB hardware, including a tracking process for internal subcomponents whose replacement/upgrade may necessitate additional non-interference testing.

## 12.7 Mitigation Strategy

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

- a. system design
- b. separate and backup power sources
- c. redundant EFB applications hosted on different EFB platforms
- d. paper products accessible for use by crewmembers, and/or
- e. procedural means.

## 12.8 Procedural Mitigations

If one or more on-board 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.

## 12.9 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.

## 12.10 Database Update Process

- a. The operator needs to establish a method for revising EFB databases. The method of data revision should ensure integrity of the data 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 programme changes must be controlled and tested prior to use in flight. Operators should not perform database and/or application software changes during operations (taxi, take-off, in-flight, landing).
- b. Operators also need to establish revision control procedures so that flight crews and others can ensure that the contents of 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 system.

## 12.11 Software Revision Process.

- a. 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 programmes meet the intended function. Unauthorised 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 approved applications, operators should use approved Service Bulletins (SB) or other acceptable technical data per Rule Part 21 Appendix D. In addition to the operator's responsibilities described above, it is also the responsibility of the pilot in command (PIC) to verify that any EFB depiction of an *en route*, terminal area, approach, airport map, or section 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.
- b. The operator should identify a means to demonstrate that adequate security measures are in place to prevent malicious introduction of unauthorised 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.

## 12.12 Special Data Storage and Retrieval Considerations.

- a. The EFB system needs to permit any authorised representative of CAA or the Transport Accident Investigation Commission (TAIC) to retrieve, view, or print the information contained in any EFB system upon reasonable request. If CAA or TAIC requires an operator to provide information, the operator must provide the data in a format that the requesting agency can use.

- b. 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.

## **12.13 Training**

Parts 121, 125 and 135 require operators to establish suitable flight crew training programmes that are applicable to the aircraft type to be used, including any special equipment fitted for the intended operation. EFB training should be integrated and incorporated into existing training modules during initial, transition, and recurrent training, when appropriate.

Basic training around EFBs should be generic and attached to the issue of an Instrument Rating (IR) and recaptured at renewal. From there, the specific approval under section 121,125 or 135 should be part of initial or transition training and the respective IR competency check confirm adequate knowledge and correct use of the EFB. Having the generic EFB training/knowledge tested at the initial IR stage will cover any training required for a Part 91 operation and ensure there is a base line.

Training should emphasise, but is not limited to, the following subjects and any other areas emphasised in this AC:

- a. The operation and controls of applicable EFB hardware, to include components and peripherals.
- b. The operation of the available applications.
- c. The awareness of new EFB program procedures.
- d. The differences between a PED and an EFB.
- e. Limitations of EFB information, to include the relationship between the use of an EFB with traditional installed avionics and conditions (including phases of flight) when information on the EFB should be tempered or terminated.
- f. A description of EFB failures and applicable operational procedures, to include procedures for obtaining a backup.
- g. Procedures for fighting lithium-ion battery fires.
- h. A description of security concerns procedures, such as operational or security procedures.
- i. Crew Resource Management (CRM) training in EFB procedures and use preflight checks of the system, the use of each application on the EFB (to include display and application management), and procedures for cross-checking data entry and computed information.

### **12.13.1 Training of Non-Flight crew Members.**

EFB training is required for non-flight crew members if they are using similar devices and applications and are interacting with flight crew members using the same devices and applications. Examples are maintenance personnel, loading personnel, and dispatchers. Training must emphasise the coordinated procedures with flight crew members.

## **12.13.2 Training Considerations for Installed Equipment**

For EFB applications displayed on installed equipment, there may be additional training required. Additional conditions, limitations, and procedures defined in an AFM, Airplane Flight Manual Supplement (AFMS), Rotorcraft Flight Manual (RFM), Rotorcraft Flight Manual Supplement (RFMS), or another form of documentation must be included in an operator's training program. This additional documentation may contain the following, which must be addressed in training:

- a. Descriptions of authorised special flight manoeuvres, operations, and procedures the operator conducts when using an EFB.
- b. Any special pilot/controller procedures when using EFB-based information.
- c. Geographical areas authorized for specific EFB operations, if applicable.
- d. Authorized methods to defer inoperative EFB equipment.

## **12.13.3 Practical Training.**

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

## **12.13.4 Part 91 Operators.**

The primary source of operational and training guidance will be provided through the FAA/Industry Training Standard (FITS), which can be obtained through the EFB equipment manufacturer. The appropriate FITS programme may be used to determine the appropriate best practices for familiarisation and use of the equipment. Each operator's EFB programme should identify and document user training in support of the use of an EFB. Also see section 12.13 above.

## **12.14 Simulator and Flight Evaluations.**

a. **Simulator Evaluations.** Simulators and other approved training devices (such as procedures trainers) may be used as a tool to evaluate the overall quality of the training given and/or evaluate EFB system performance before granting operational approval 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 flight crew's use of displays
- EFB control use
- alert reactions
- auto-ranging configuration
- self-tests
- flight crew procedures, and

- failure mode analysis.
- b. **Flight Evaluations.** Base the number of flight evaluations required to validate a particular EFB system before authorizing its use (including its hosted applications) on:
- the type of aircraft
  - aircraft system architecture
  - flight crew workload considerations
  - credit given for previously certified installations, and
  - past simulator and ground testing.

CAA needs to evaluate the actual requirement for a flight test for each request. CAA will determine if an approved training device or an actual flight evaluation is required. For example, first-time model installations and first-time hosted applications will generally require a flight test. If adequate evaluation on the ground or in simulators of changes in the EFB system, including software upgrades, is not possible, it may require flight testing.

## 12.15 Need for Approved Manuals

The aircraft must at all times carry on-board an approved AFMS when the EFB equipment is installed in accordance with applicable airworthiness regulations unless otherwise approved by the Director.

## 12.16 Instructions for Continued Airworthiness

- a. Although a source independent of the operator may provide on-going maintenance and support for EFB equipment, the operator is responsible for compliance with all regulatory requirements.
- b. The maintenance or inspection programme should identify inspection items, establish time-in-service intervals for maintenance and inspections, software updates, and provide the details of the proposed methods and procedures. The maintenance or inspection programme should also include ICAs for the STC or CAA design or installation approval.
- c. It is important for operators to coordinate early in the process with CAA on airworthiness related considerations to determine the appropriate authorisations necessary for each EFB application.

## 12.17 Minimum Equipment Lists (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).

## 12.18 EFB Substitution/Use in More Than One Aircraft

The operator may substitute compatible EFBs for use in other aircraft. Specific procedures to ensure that an EFB is fully compatible with other aircraft and their systems are necessary 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 system moves to another

aircraft. For approved replacement EFBs, it will be necessary to ensure that the replacement EFBs are authorised for use by CAA.

## 12.19 User Feedback

Part 121 and 135 operators must, while Part 91 are recommended to, implement a formal process, using the SMS, for gathering feedback on the EFB program, to include any irregularities, malfunctions, or lessons learned. Use this process during design, installation, modifications, or improvements to procedures and/or training.

## 12.20 Paperless Operations Approval.

- a. **Certificated Operators.** An operational approval will be issued, and the relevant Operational Specification will be revised to include EFBs.
- b. **Part 91 (Non-Certificated Operators).** EFBs used in Part 91 operations in lieu of paper reference material is authorised provided the EFB meets the criteria set forth in this AC for the intended functions. 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.
  - i. Any Type A or Type B EFB application, as defined in this AC, may be substituted for the paper equivalent. When the EFB replaces aeronautical information required by 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.
  - ii. The EFB system on board must be at least 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.
  - iii. The aircraft operator and/or PIC is responsible to make 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, pre-flight 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.

## 12.21 Electronic Authorisation

Final operational approval for use of electronic documents, in lieu of required paper documents, requires:

- a. operational evaluation, including the validation report, completion.
- b. reliable EFB system information available for each flight crew member
- c. compliance with Operational Suitability Reports, if available
- d. EFB maintenance and fault reporting procedures are in place

- e. non-interference testing as specified within AC 91-5 and this AC
- f. when Type B applications, and certain eligible approved applications (e.g. AMMD) software is used, results from rapid decompression testing and related mitigating procedures, and
- g. Operational Specifications authorisation, as appropriate.

## APPENDIX 1: EXAMPLES OF TYPE A EFB APPLICATIONS REQUIRING CAA AUTHORISATION

- Flight Operations Manuals (FOM).
- Company standard operating procedures (SOP).
- Airport diversion policy guidance, including a list of special designated airports and/or approved airports with emergency medical service (EMS) support facilities.
- Operations specifications (Op Specs).
- 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 (such as a reference for take-off 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 modelling 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.
- Air Transport Association of America (ATA) 100-format maintenance discrepancy write-up codes.
- Required Very High Frequency Omni-directional 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.
- Flight crew required rest logs.
- Flight crew qualification logs (such as aircraft qualifications, Class II flight crew qualifications, Category (CAT) III) qualifications, high minimums logs, night currency logs, pilot-in-command (PIC) qualifications for special areas, routes, and airports for Part 121 certificate holders and special airports qualifications).
- Captain's report (i.e., captain's incident reporting form).
- Flight crew survey forms (various).
- EMS reference library (for use during medical emergencies).
- Trip scheduling and bid lists.
- Aircraft's captain's logs.
- Aircraft's CAT II/CAT III landing records.
- Antiterrorism profile data.
- Hazardous materials (hazmat)/oxidizer look-up tables.
- ICAO Doc 9481-AN/928, Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods.
- Customs declarations and bis-security inspection/clearance form.
- Special reporting forms, such as near mid-air collision (NMAC) reports, bird and wildlife encounters, owner-initiated Service Difficulty Reports (SDR), etc.
- Incidents of interference to aircraft electronic equipment from devices carried aboard aircraft.
- Current fuel prices at various airports.
- Realistic training modules, including "PC at home" training applications, "off-duty" training materials review, and pre-flight "mission" rehearsals.
- Flight examiner 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.
- NZ Civil Aviation Rules.
- Look-up and completion of various reporting forms; e.g. company-specific forms, NASA's ASRS reports, NMAC reports, wildlife strike and hazard reports, etc.
- Maintenance personnel signoff of discrepancy form. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Flight crew qualifications recordkeeping, including aircraft qualifications, CAT II/III, high minimums, landing currency, flight 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, etc.).
- Cabin maintenance write-ups. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)

## APPENDIX 2. EXAMPLES OF TYPE B EFB APPLICATIONS REQUIRING CAA AUTHORISATION FOR USE

- Aircraft Flight Manuals (AFM) (or Rotorcraft Flight Manuals (RFM)) and Aircraft Flight Manual Supplement (AFMS).
- Flight Attendant (F/A) manuals.
- FOMs, including emergency procedures.
- Approved electronic signature using public/private key technology (PKI).
- Take-off, 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 modelling.
- Master flight plan/updating.
- Interactive plotting for Class II navigation.
- Mission rehearsals.
- 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 pre-composed format from accepted sources.
- Panning, zooming, scrolling, and rotation for approach charts.
- Pre-composed or dynamic interactive electronic aeronautical charts (e.g. en route, area, approach, and airport surface maps) including, but not limited to, centring and page turning.
- Electronic checklists, including normal, abnormal, and emergency. EFB electronic checklists cannot be interactive with other aircraft systems.
- Applications that make use of the Internet and/or other Aircraft Operational Communications (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.

- Cabin-mounted video and aircraft exterior surveillance camera displays.

## APPENDIX 3: APPLE IPAD AND OTHER SUITABLE TABLET COMPUTING DEVICES AS ELECTRONIC FLIGHT BAGS (EFB)

### Purpose:

This Appendix provides information about the use of the iPad and other suitable tablet computing devices as EFBs. In addition, it provides information about EFB use and the CAA process that may be helpful to operators seeking authorisation to use an EFB.

### Background:

Recently, the Federal Aviation Administration (FAA) authorised a certificated operator to use an iPad as a portable EFB. In this particular case, the operator is using the iPad with the *Jeppesen Mobile TC App* to display approach plates, terminal procedures, and airport diagrams. This operator worked closely with their certificate holding district office, Jeppesen, and Apple during the application and evaluation process.

### Applicable Guidance:

*FAA Order 8900.1, Flight Standards Information Management System, volume 4, chapter 15, section 1, Electronic Flight Bag Operational Authorisation Process, and volume 3, chapter 18, section 3, OPSPEC/MSPEC/LOA A061, USE OF ELECTRONIC FLIGHT BAG.*

*FAA AC (AC) 120-76B, Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices.*

*FAA AC 91-78, Use of Class 1 or Class 2<sup>3</sup> Electronic Flight Bag (EFB),* has information for those conducting operations under Title 14 of the Code of Federal Regulations (14 CFR) part 91.

### Hardware:

The iPad is commercial-off-the-shelf (COTS) electronic hardware that is not approved or certified by the CAA. However, it can be authorised for use by a flight examiner if it meets the EFB criteria discussed in this AC. For air operator certificate holders, and operational approval via Operational Specifications must be issued to authorise the use of EFBs. For part 91 operators, CAA authorisation for use is not required. However, installation and airworthiness requirements specified in this AC are still applicable.

### Software:

The *Jeppesen Mobile TC App* displays approach plates, terminal procedures, and airport diagrams and is defined as a Type B software application per this AC. The display of *en route* chart aeronautical information was not part of this particular evaluation or operational approval. To be used in phases of flight, an EFB displaying Type B software must be secured and viewable. A kneeboard is one way to accomplish this.

### Operator Authorisation:

The authorisation process that the CAA uses for certificate holders and programme managers is contained in this AC. Although the iPad is a relatively new computing device, when using it as an EFB it is treated the same as any other COTS device, subject to the operational approval and limitations

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<sup>3</sup> Note that this FAA AC still uses the old Class 1 and Class 2 nomenclature.

applicable to portable EFBs. Operational Specifications text can be added to document an evaluation period. At the end of a successful evaluation period, the operator is authorised to use the iPad as an EFB to replace certain required paper products.

Operators that desire to use the iPad or any other suitable tablet computing device as a substitute for paper products, including aeronautical information such as approach plates, terminal procedures, and airport diagrams, must show compliance with the guidance in this AC. Each authorisation process is considered unique, because of differences in each operator's aircraft types, training programmes, operational procedures, intended function of the EFB, etc.

For part 91 operators, the use of an EFB in lieu of paper is the decision of the aircraft operator and/or the pilot in command, AC91-18, *Aircraft Software Configuration Management* and this AC contain guidance on replacing paper products, including aeronautical charts, with an EFB. Operators transitioning to a paperless cockpit should undergo an evaluation period during which the operator should carry paper backups of the material on the EFB. During this period, the operator should validate that the EFB is as available and reliable as the paper-based system being replaced. All part 91 operators should also document compliance with Rule Part 91.7, *Portable electronic devices*.