



Advisory Circular

AC91-20

Guidelines for the Approval and Use of Electronic Flight Bag Devices

15 April 2016

General

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

An AMC is not intended to be the only means of compliance with a rule, and 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 Advisory Circular.

An Advisory Circular may also include **Guidance Material (GM)** to facilitate compliance with the rule requirements. Guidance material must not be regarded as an acceptable means of compliance.

Purpose

This Advisory Circular provides an acceptable means of compliance and guidance for the approval and use of both portable and installed Electronic Flight Bag (EFB) devices in aircraft.

Related Rules

This Advisory Circular relates specifically to the civil aviation rules listed in Section 4.

Change Notice

Subject to “Memorandum for Technical Cooperation” between the CAA of Mongolia and New Zealand on mutual cooperation in implementation of Assembly Resolution A29-3: Global Rule Harmonization, 29th ICAO Assembly, 1992, which urges States to promote global harmonization of national rules, dated 6th of May, 1999, Mongolian Civil Aviation Safety Regulation has been reconciled to the Civil Aviation Regulation of New Zealand.

Amendment 164 of Annex 1 to the Chicago Convention on International Civil Aviation urges flight crew members, ATC personnel and aircraft maintenance engineers to comply with the language proficiency requirements; and

Under Article 14 of the Civil Aviation Law of Mongolia 1999, “Use of foreign language in civil aviation” the AC has been released in English version only, in order to prevent any mistranslation and misuse of the aviation safety related documents.

This AC91-20 was developed based on NZ AC91-20, dated on 30 January 2012.

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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 or under the authority of an air operator certificate under CAR Part 119. Many of these paper documents were carried by crew in their flight bags; the move to more 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 Advisory Circular provides an acceptable means of compliance for operators conducting operations under Parts 121, 125, or 135 to transition from the paper documents in a traditional flight bag, to an electronic flight bag (EFB). 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 civil aviation rules, but these operators must still comply with the portable electronic device (PED) requirements of rule 91.7.

3. Applicability

This Advisory Circular is applicable to all 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 Advisory Circular 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 an 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 Advisory Circular.

4. Related Rules

The civil aviation 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 are required to be carried in the aircraft except where there is an authorisation for an equivalent document acceptable to the Director to be carried.

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 meet 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 in the form of electronic documents that are copies of existing paper documents or they may be a computational capability. 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 methodologies.

5. References

The following documents are referenced in this Advisory Circular:

Federal Aviation Administration:

AC 20-CNTL Controls for Flight Deck Systems

AC 20-EFB Installation of Electronic Flight Bag Components

AC 20-159 Obtaining Design and Production Approval of Airport Moving Map Display Applications Intended For Electronic Flight Bag Systems

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

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

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

European Aviation Safety Agency:

EASA TGL 36 APPROVAL OF ELECTRONIC FLIGHT BAGS (EFBs)

6. Definitions & Abbreviations

6.1. Definitions

For the purposes of this Advisory Circular, 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.

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.

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

Portable Electronic Device (PED) Includes Class 1 and 2 EFBs.

6.2. Abbreviations

For the purposes of this Advisory Circular, the following abbreviations are defined:

AAC	means Aircraft Administrative Communications
AFM	means Aircraft Flight Manual
AFMS	means Aircraft Flight Manual Supplement
COTS	means Commercial off the Shelf
EFB	means Electronic Flight Bag
FITS	means FAA / Industry Training Standards
IFR	means instrument flight rules
PED	means Portable Electronic Device
VFR	means visual flight rules

6.3. Symbols

For the purposes of this Advisory Circular, the following symbol is defined:

§ means US 14 CFR Part XX and / or EASA CS XX where XX is the relevant Part number.

7. Background

7.1. Portable Electronic Devices

Class 1 and Class 2 EFBs are both considered PEDs; the classification of EFBs is set out in section 9 of this Advisory Circular. Any PED that is used in an aircraft must comply with the use of any PED in aircraft is subject to compliance with PED requirements in rule 91.7; the PED regulations' applicability addresses 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.

Aircraft operated VFR under Part 91 require no EFB authorisation or compliance with this Advisory Circular, provided the EFB does not replace any equipment or operating information required by the Rules. PED regulatory methods for compliance are addressed in this Advisory Circular and Advisory Circular 91-5. There are 2 separate methods of compliance respective to Non-EFB PEDs and EFB PEDs. Non-EFB PED compliance is in accordance with Advisory Circular 91-5 which restricts the use of PEDs in flight operations except when safely in cruise and/or above 10,000 feet. All PEDs are subject to these restrictions unless they are an EFB authorised by the Director. To be an authorised EFB the PED must provide authorised EFB functions listed in Appendices 1 and 2 and meet the additional evaluation criteria in sections 10 and 11. An authorised EFB PED may be used in all phases of flight operations.

7.2. Electronic Flight Bags

EFBs can electronically store and retrieve documents required for flight operations, such as the General Operations Manual (GOM), minimum equipment lists (MEL), operations specifications (Op Specs), and operational control documents. EFBs that have been tested and determined not to cause interference to the aircraft systems may be used during all phases of flight operations. Refer to paragraph 10.9 for further details.

In the past, some of these functions were traditionally accomplished using paper references or were based on data provided to the flight crew by an airline's "flight dispatch" function. The scope of the EFB system functionality may also include various other hosted databases and applications. Physical EFB displays may use various technologies, formats, and forms of communication. These devices are sometimes referred to as auxiliary performance computers (APC) or laptop auxiliary performance computers (LAPC).

8. Scope

This Advisory Circular provides guidance to assist operators and flight crews in transitioning from the paper products in a traditional flight bag to an electronic format. This Advisory Circular provides specific guidance material for certain EFB applications and establishes guidance for operational use of EFBs by flight crew. Use

this Advisory Circular in combination with other material contained in current Communication, Navigation, and Surveillance (CNS) Advisory Circulars or other relevant guidance material. This Advisory Circular does not supersede existing operational guidance material.

Own-ship position is not authorised for display or use for any application, for navigation or otherwise, on a Class 1 or Class 2 EFB in flight. Do not use this Advisory Circular by itself to add own-ship position on moving maps on Class 1 and Class 2 EFBs. 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 an acceptable means to use an airport moving map display (AMMD) during ground operations on a Class 2 or installed EFB, see the current edition of FAA AC 20-159, Obtaining Design and Production Approval of Airport Moving Map Display Applications Intended for Electronic Flight Bag Systems. The AMMD, which provides depiction of an own-ship symbol for ground operations, is not identified as a Type A or Type B application. It may be approved as an approved application if the manufacturer obtains a CAA design and production approval per FAA AC 20-159. Evidence of a Technical Standard Order Authorisation (TSOA) design approval for the AMMD application approved software is an adequate indication to the CAA for use with the hosted Type A and Type B applications in an EFB system that the manufacturer has demonstrated to be compatible.

This Advisory Circular does not specifically address all criteria for the design and development of EFB systems or applications. The design and development of EFB hardware or software is considered to be a “major design change” so needs to be carried out with CAA oversight; the degree of oversight will be a function of the criticality of the functions being implemented.

9. System Classifications

9.1. Hardware Classes of EFB Systems

There are 3 EFB hardware classes as outlined below:

9.1.1 Class 1 EFBs

These EFBs are portable, COTS devices that are not mounted or attached to the aircraft. When used, Class 1 EFBs that have Type B applications for aeronautical charts, approach charts, or electronic checklists must be secured and viewable during critical phases of flight and must not interfere with flight control movement. An EFB attached to the pilot's leg (e.g. kneeboard type) may still be considered a Class 1 EFB because it is not attached to the aircraft. Class 1 EFBs should be securely stowed when not in use.

Class 1 EFBs may not be used as navigation devices and the ship's own position should not be displayed.

The operator should document EFB non-interference to show operational suitability and compliance with the guidance in AC 91-5 and this AC for aircraft Electromagnetic Compatibility.

9.1.2 Class 2 EFBs

These EFBs are typically attached to the aircraft by a mounting device and may be connected to a data source, a hard-wired power source, and an installed antenna, provided those connections are installed in accordance with the airworthiness regulations applicable to the aircraft. In order to be considered portable, tools must not be required to remove an EFB from the flight deck and a pilot must be able to perform the task. Portable EFBs must be located on the flight deck and controlled by the flight crew during all flight operations. The components of the Class 2 EFB include all the hardware and software needed to support EFB intended functions. A Class 2 EFB may consist of modular components (e.g. computer processing unit, display, controls). Any EFB hardware that is not accessible on the flight deck by the flight crew and / or not portable must be installed in accordance with applicable airworthiness regulations. Class 2 EFBs may not be used as navigation devices and the ship's own position should not be displayed.

Note: Normally, portable EFBs are limited to hosting Type A and Type B software applications or TSO functions limited to a minor failure effect classification. However, approved software associated with the provision of own-ship position on AMMDs may be hosted on Class 1 or Class 2 portable EFBs. See FAA AC 20-159 for details.

- a. The operator should document EFB non-interference to show operational suitability and compliance with the guidance in AC 91-5 and this AC.
- b. CAA airworthiness approval is limited to the aircraft connectivity provisions (i.e., mounting device (e.g. arm-mounted, cradle, yoke-clip), data connectivity, installed antennas, and power connection) installed in accordance with applicable airworthiness regulations.
 - EFB mounting requires installation in accordance with applicable airworthiness regulations for integrity of mounting, location, non-impeded egress, accessibility to instruments and controls, physical interference, etc.
 - EFB data connections require installation in accordance with applicable airworthiness regulations to ensure non-interference and isolation from aircraft systems during transmission and reception. The EFB data connection may receive information from any aircraft system as well as receive or transmit information for AAC purposes. Connectivity may be wired or wireless.
 - Class 2 EFB hardware, internal components, and software do not require CAA airworthiness approval.

- c. Class 2 EFBs may be required to be compliant with RTCA/DO-160, Environmental Conditions and Test Procedures for Airborne Equipment, radio frequency (RF) emission, decompression, and altitude testing, if removing required paper products.
- d. Class 2 EFB mounting devices, installed antennas, power connection, and data connectivity provisions installed in accordance with applicable airworthiness regulations may require Aircraft Flight Manual (AFM) or Aircraft Flight Manual Supplement (AFMS) revisions.
- e. Removal of Class 2 EFB from the aircraft may be done through an administrative control process (e.g. logbook entry).
- f. Operators must determine non-interference and operational suitability with existing aircraft systems for all flight phases and ensure that the system performs the intended function.
- g. Class 2 EFBs may require aircraft certification to conduct a human factors evaluation of the EFB mount and cockpit location.
- h. Operators must determine the usage of hardware architectural features, persons, procedures, and/or equipment to eliminate, reduce, or control risks associated with an identified failure in an EFB.

9.1.3 Installed EFBs

The term Class 3 EFB is obsolete; these systems are now referred to as installed EFB systems and are part of the aircraft type design.

Installed EFBs are installed equipment requiring an airworthiness approval, except that they may host Type A and B applications. The airworthiness approval should cover the integrity of the EFB hardware installation (e.g. server, display, keyboard, power, switching), including hardware and software qualification. Such aspects as the human machine interface should also be addressed. Installed EFB system certification requirements enable additional applications and functions.

9.2. Software Applications for EFBs

The functionality associated with the EFB system depends upon the applications loaded on the host. The classification of the applications into 2 Types (A and B) is intended to provide clear divisions between the scope and therefore the approval process applied to each one. Although guidelines and examples are provided in this Advisory Circular to provide guidance as to the Type associated with a particular application, there is still the potential for misclassification.

Applicants should be aware of 2 particular issues. The Type of software application will influence the level of participation of the CAA and the involvement or otherwise of the 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 Original

Equipment Manufacturer (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 early on in the approval process from the CAA.

9.2.1 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 non-critical 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 have 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-178B.
- 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.

9.2.2 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-178B.
- 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: Class 1 or Class 2 EFBs must not display own-ship position while in flight. For use of own-ship position on the ground see FAA AC 20-159.

- 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. Data link EFB functions may display approved or unapproved sources of weather. Weather and aeronautical information such as data-linked meteorology information (MET) and Aeronautical Information Service (AIS) products are for advisory use only. These products enhance situational awareness (SA), but lack sufficient resolution, service delivery reliability, and updating necessary for tactical manoeuvring/use. Do not use data-linked MET and AIS products as a sole source for making tactical in-flight decisions regarding flight safety when avoiding adverse weather, airspace, or obstacle hazards, such as negotiating a path through a weather hazard area. Current data-linked MET and AIS products support strategic decision making such as route selection to avoid a weather hazard area in its entirety.
- g. Data link graphical weather from sources such as XM and next generation weather radar (NexRad) may be from unapproved sources of advisory weather information and can only be used for strategic planning purposes. Do not use unapproved sources of data link graphical weather information for tactical decisions during critical phases of flight because data quality is uncontrolled for aviation use. In some instances, data link textual weather may be from an approved weather source, depending on the data link system and the weather provider. Do not use data link graphical weather data as a substitute for airborne weather radar or thunderstorm detection equipment.
- h. 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.

i. 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.

j. 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.

k. 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 takeoff power time limits. Type B applications for performance must accurately address engine inoperative gradients and obstacle clearance plane and/or weight limits. Transition from airport area performance to en route climb performance and obstacle clearance must be addressed. Type B applications are suitable only 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.

I. Develop operational procedures in accordance with § 121.133 for aircraft operated under this part. For Part 121 operators, EFB operating procedures must be developed and included in the operators exposition. These procedures should define the roles that the flight crew and dispatch/flight following have in creating and reviewing performance calculations. Op Specs approvals must be issued as appropriate to the operator.

9.2.3 Approved Software Applications

The term Type C EFB application software is obsolete and will be referred to in future as approved EFB software applications.

Approved applications are Regulatory Authority approved software using RTCA/DO-178B compliance, or other acceptable means. Software approval guidelines are found in RTCA/DO-178B 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 the 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 Class 1 or Class 2 EFBs provided the software system requirements are met. Approved applications for W&B and / or performance are those applications approved or accepted by a Regulatory 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. Contact the CAA for assistance regarding applications offered by aircraft manufacturers or STC holders for specific aircraft. The operator may utilise approved W&B and / or performance applications on Class 1 or Class 2 EFBs provided the software system requirements are met.
- d. Approved applications may be granted TSO approvals by some Regulatory authorities. EFB approved applications that receive a TSO approval may be

authorised for use on Class 1 and Class 2 EFB 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. In-flight depiction of own-ship position is classified as a major safety effect and is not authorised on a Class 1 or Class 2 EFB.
- 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 Hardware Considerations

10.1. Paper Data Removal

At least 2 portable functional EFBs are required to 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.

10.2. Electrical Backup Power Source

System design must consider the source of electrical power, the independence of the power sources for multiple EFBs, and the potential need for an independent battery source. 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.

Class 1 and Class 2 EFB electrical power source provisions that are certified on § 25 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 CAA.

10.3. Battery Backup

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 to ensure the replacing of batteries is completed as required, but no less often than the EFB manufacturer's recommended interval.

10.4. Battery Replacement

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.

10.5. Lithium Batteries

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 Advisory Circular refers to the battery pack, its cells, and its circuitry. 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 drives design considerations for system integration, cell, pack, host device, and total system reliability. It also covers how to maintain critical operational parameters with respect to time, environment, extremes in temperature, and the management of component failure.

There are other regulations that apply to the carriage and use of lithium batteries on-board aircraft. US DOT regulations do not allow more than 25 grams of equivalent lithium content (ELC) or 300 watt hours (WH) per battery pack in air travel; the DOT regulations apply to the shipment of lithium ion batteries, not to batteries installed in PEDs. For more information see <http://safetravel.dot.gov>.

10.6. Lithium Battery Cautions

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 call for the following standards:

a. **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.

b. **Showing Compliance.** The operator provides the 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).

10.7. Rechargeable Lithium-Type Battery Maintenance, Storage, and Functional Check

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

10.8. Use of Aircraft Electrical Power Sources

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.

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.

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 Class 1 and Class 2 EFBs unless specified in this Advisory Circular.

10.9. Environmental Hazards Identification and Qualification Testing

Certain environmental hazards must be evaluated for Class 1 and Class 2 EFBs to ensure their safe use in anticipated operating environments. Evaluate Class 1 and Class 2 EFB system RF emissions data needs in accordance with AC 91-5 and this Advisory Circular. Class 1 and Class 2 EFBs should demonstrate that they meet appropriate industry-adopted environmental qualification standards for radiated emissions for equipment operating in an airborne environment. It is necessary to demonstrate that any Class 1 or Class 2 EFB used in aircraft flight operations will have no adverse impact on other aircraft systems (non-interference). The manufacturer, installer, or operator may accomplish the testing and validation to ensure proper operation and non-interference with other installed systems. Test for possible interference while moving a portable EFB about in the cockpit. Additionally, altitude and rapid decompression testing may need to be accomplished to demonstrate Class 1 or Class 2 EFB operation in the anticipated operating envelope of the aircraft in which they will be used.

a. **Non-EFB Non-Interference Testing.** It is the user's/operator's responsibility to determine that the operation of a PED will not interfere, in any way, with the operation of aircraft equipment. AC 91-5 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. Class 1 and Class 2 EFB require additional guidance for non-interference testing contained in paragraphs 10.10 d and e, in addition to the guidance in AC 91-5.

b. **EFB PED Non-Interference Compliance Test Method.** In order to operate a PED in other than a non-critical phase of flight, the user / operator is responsible for ensuring that the PED will not interfere in any way with the operation of aircraft equipment. The following methods are applicable to Class 1 and Class 2 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.

- i. The two following steps complete Method 1 for compliance with PED non-interference testing for all phases of flight.

1. Step 1 is to conduct an electromagnetic interference (EMI) test in accordance with RTCA/DO-160, Section 21, Category M. An EFB vendor or other source can conduct this Step 1 test for an EFB user / operator. An evaluation of the results of the RTCA DO-160 EMI test can be used to determine if an adequate margin exists between the EMI emitted by the PED and the interference susceptibility threshold of aircraft equipment. If Step 1 testing determines 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.

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

- ii. Method 2 for compliance with PED non-interference testing for all phases of flight is a complete test in each aircraft using an industry standard checklist. This industry standard 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.

c. **EFBs With Transmitting Functions.** An EFB with a transmitting function can only use that function when the aircraft is on the ground or is operating 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.

d. Rapid Depressurisation Testing

- i. **Environmental Tests.** Other environmental testing, specifically testing for rapid depressurisation, may be needed. However, since many Class 1 and Class 2 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.
- ii. **Rapid Decompression Testing.** Determining an EFB device's functional capability requires rapid decompression testing when utilising 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 pressurized aircraft. Rapid decompression testing must comply with RTCA DO- 160 guidelines for rapid decompression testing up to the maximum operating altitude of the aircraft in which the EFB is to be used. Similarity of a particular EFB to a unit already tested may be used to comply with this requirement. It is the responsibility of the operator to provide the rationale for the similarity.

1. Pressurised Aircraft. It is necessary to conduct rapid decompression testing for Class 1 and / or Class 2 EFB devices when the EFB has Type B applications and is used to remove paper-based aeronautical charts in a pressurised aircraft in flight. When a Class 1 or Class 2 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 Class 1 or Class 2 EFB device demonstrates rapid decompression testing while turned off and is fully functional following rapid decompression, then procedures will need to be developed to ensure that one of the two EFBs 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).

2. Un-Pressurised Aircraft. Rapid decompression testing is not required for a Class 1 or Class 2 EFB used in an un-pressurised aircraft. It is required that the EFB 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.

10.10. 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. Consider the following design practices:

- 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 minimize 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.** Mount the device so that the EFB is easily accessible. When the EFB is in use and is being viewed or controlled, it should be 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 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 located 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. It is necessary to provide a means 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.
- d. **Stowage Area for EFB.** EFB stowage is required for all EFBs not secured in or on a mounting device. If an EFB mounting device is not provided, designate an area to stow the EFB. Stowage requires an inherent means to prevent unwanted EFB movement when not in use. Do this in a manner that prevents the device from jamming flight controls, damaging flight deck equipment, or injuring flight crew members should the device move about as a result of turbulence, maneuvering, or

other action. Acceptable stowage locations for a Class 1 EFB includes the inside compartments of the pilot's flight bag.

e. **Data Connectivity with Aircraft Systems (Wired or Wireless).** 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 having 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:

- i. **Read-Only Access.** The design of interface protection devices that provide read-only access must ensure protection by using one-way communication of data.
- ii. **Transmit-Receive Access.** The design of interface protection devices that provide transmit (talk) and receive (read) capability must include:
 1. **Partition.** The design must provide a means of partition for applications that have not been approved from installed systems on the aircraft.
 2. **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).
 3. **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. Design the data interface protection device to prevent any potential security threats. Provide plans for verifying and maintaining the security protection mechanisms and functionality to adequately address each threat.

11. EFB System Design Considerations

11.1. EFB System Design and Usability

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

11.2. Human/Machine Interface

The EFB user interface should provide a consistent and intuitive user interface within and across various EFB applications. The interface design (including, but not limited to, data entry methods, colour-coding philosophies, and symbology) should be consistent across the EFB and various hosted applications. These applications should also be compatible with other flight deck systems.

11.3. Legibility of Text

Text displayed on the EFB should be legible to the typical user at the intended viewing distance(s) and under the full range of lighting conditions expected on a flight deck, including use in direct sunlight. Users should be able to adjust the screen brightness of an EFB independently of the brightness of other displays on the flight deck. In addition, when incorporating an automatic brightness adjustment, it should operate independently for each EFB in the flight deck. Buttons and labels should have adequate illumination for night use. All controls must be properly labelled for their intended function. Consideration should be given to the long-term display degradation as a result of abrasion and aging.

11.4. Electronic Display of Aeronautical Charts

a. Electronic aeronautical charts should provide a level of information integrity comparable to paper charts. Visual, instrument, and aerodrome charts (see International Civil Aviation Organization (ICAO) Annex 4) that are depicted should contain the information necessary, in appropriate form, to conduct the operation to at least a level of safety equivalent to that provided by paper charts. The screen size and resolution must be demonstrated to display information in a comparable manner to paper aeronautical charts and the data it is intended to replace. The screen must display an instrument approach procedure (IAP) chart in an acceptable aeronautical chart format similar to a published paper chart. The screen must be large enough to show the entire IAP chart at once, with the equivalent degree of legibility and clarity as a paper chart. This requirement is not meant to preclude panning and zooming features, but is intended to prevent a workload increase during the approach phase of flight. Alternate representations of IAP charts will need to be evaluated for operational suitability by the FSB process for functionality and human factors. Aeronautical navigation charts (i.e., VFR navigation charts, low and high altitude en route charts, and terminal procedure publications) will need to be evaluated for operational suitability by the FSB process. Panning, scrolling, zooming, rotating, or other active manipulation is permissible for these Type B applications. An EFB display may not be capable of presenting an entire aerodrome chart (airport diagram) if the chart is the expanded detail (fold over) type. In this case, a moving map centring feature (not own-ship position) may be desirable. Aerodrome charts must include all information useful for airport operation. For a description of the requirements for AMMD, see AC 20-159.

NOTES:

1. When scrolling documents on screens, experience and human factors research as shown that obscured information on the sides of charts will be guessed by the operator rather than scrolled horizontally and read. Vertical scrolling has not been found to be such a significant problem. Horizontal scrolling should therefore be avoided where practicable.

2. Software with an airworthiness approval performing an intended function of aeronautical charting as a replacement for paper could be utilised to support operational requirements without the need for further operational evaluation for use.

b. The Operational Suitability Report (OSR) report should include, but not be limited to, the following:

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

11.5. Responsiveness of Application

The system should provide feedback to the user when a user input is accepted. If the system is busy with internal tasks that preclude immediate processing of user input (e.g. calculations, self-test, or data refresh), the EFB should display a “system busy” indicator (e.g. clock icon) to inform the user that the system is occupied and cannot process inputs immediately. The timeliness of system response to user input should be consistent with an application’s intended function. The feedback and system response times should be predictable to avoid flight crew distractions and/or uncertainty.

11.6. Off-Screen Text and Content

If the document segment is not visible in its entirety in the available display area, such as during “zoom” or “pan” operations, the existence of off-screen content should be clearly indicated in a consistent way. For some intended functions it may be unacceptable if certain portions of documents are not visible. The basis of this evaluation should be on the application and intended operational function. If there is a cursor, it should be visible on the screen at all times while in use.

11.7. Active Regions

Active regions are regions to which special user commands apply. The active region can be text, a graphic image, a window, frame, or other document object. These regions should be clearly indicated.

11.8. Managing Multiple Open Applications and Documents

The electronic document application should provide continuous indication of which application and/or document is active if the system supports multiple open documents, or if the system allows multiple open applications. The active document is the one that is currently displayed and responds to user actions. Under non-emergency, normal operations, the user should be able to select which of the open applications or documents is currently active. In addition, the user should be able to find which flight deck applications are running and switch to any one of these applications easily. When the user returns to an application that was running in the background, it should appear in the same state as when the user left that application, other than differences associated with the progress or completion of processing performed in the background.

11.9. Input Devices

In choosing and designing input devices such as keyboards or cursor-control devices, operators should consider the type of entry to be made and flight deck environmental factors, such as turbulence, that could affect the usability of that input device. Typically, the performance parameters of cursor control devices are tailored for the intended application function as well as for the flight deck environment.

11.10. Flight crew Workload

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

11.11. Messages and the Use of Colours

For any EFB system, EFB messages and reminders should meet the requirements in § 23.1322 or § 25.1322, as is appropriate for the intended aircraft. While the regulations refer to lights, the intent should be generalized to extend to the use of colours on displays and controls. That is, the colour red should be used only to indicate a warning level condition. Amber should be used to indicate a caution level

condition. Any other colour may be used for items other than warnings or cautions, providing that the colours used differ sufficiently from the colours prescribed to avoid possible confusion. EFB messages and reminders should be integrated with (or compatible with) presentation of other flight deck system alerts. EFB messages, both visual and auditory, should be inhibited during critical phases of flight. An EFB application should avoid flashing text or symbols. Listed messages should be prioritized and the message prioritization scheme evaluated and documented.

Additionally, during critical phases of flight, the continuous presentation of required flight information must be without interruption. Examples of unwanted interruptions include un-commanded overlays, pop-ups, or pre-emptive messages (except those indicating the failure or degradation of the current EFB application). However, if there is a regulatory or TSO requirement that conflicts with the recommendation above, it supersedes this guidance.

11.12. System Error Messages

If an application is fully or partially disabled, or is not visible or accessible to the user, it may be desirable to have a positive indication of its status available to the user upon request. Certain non-essential applications such as e-mail connectivity and administrative reports may require an error message when the user actually attempts to access the function rather than an immediate status annunciation when a failure occurs. EFB status and fault messages should be prioritized and the message prioritization scheme evaluated and documented.

11.13. Data Entry Screening and Error Messages

If user-entered data is not of the correct format or type needed by the application, the EFB should not accept the data. The EFB should provide an error message that communicates which entry is suspect and that specifies what type of data it expects. The EFB system and application software should incorporate input error checking that detects input errors at the earliest possible point during entry, rather than on completion of a possibly lengthy invalid entry.

11.14. Error and Failure Modes

a. **Flight crew Error.** The system design should minimize the occurrence and effects of flight crew error and maximize the identification and resolution of errors. For example, terms for specific types of data or the format for entry of latitude/longitude should be the same across systems. Data entry methods, colour-coding philosophies, and symbology should be as consistent as possible across the various hosted EFB applications. These applications should also be compatible with other flight deck systems.

b. **Identifying Failure Modes.** The possible effects of undetected errors in each EFB application should be evaluated. The assessment should address the adequacy of the human/machine interface, accessibility of controls, ability to view controls,

annunciations, displays and printers, and the effect on flight crew workload and head-down time. The assessment should also consider the effects of flight crew (procedural) errors determined by comments from the professional pilot community. The EFB system should be capable of alerting the flight crew of probable EFB application/system failures.

11.15. Integrity Considerations

The operator must demonstrate that the EFB performs its intended functions. Additionally, data contained in the data files should be of sufficient integrity to perform the intended functions without producing false or hazardously misleading information.

12. 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 the civil aviation 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. If an operator wants to transition to a paperless cockpit, an acceptable process needs to be developed in consultation with the 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 this refers to 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. Risk mitigation report submitted to the CAA;
- b. Reliable EFB system information available for each flight crew member;
- c. A final CAA evaluation report; and
- d. Operations Specification approval.

13. Operational Approval Process

The introduction and use of EFBs in the cockpit and cabin of operations performed under 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.

13.1. 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 Civil Aviation Rules. This Advisory Circular provides guidance for all EFB equipages of all hardware classes and software types. In order for a PED to be considered an EFB, its functions must conform to the guidance in this Advisory Circular.

13.2. General Process for Approval or Acceptance

The operational approval of EFBs consists of the following 5 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.mcaa.gov.mn. The CAA and the operator should reach a common understanding of what the operator must do, what role the 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 the CAA for formal evaluation. During this phase, the 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 class of equipment and 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 the CAA, as necessary.
- c. Phase 3 begins when the 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 four concludes when the operator provides sufficient proof to satisfy the 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, the 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 Op Specs.

13.3. Operator Responsibilities

In addition to close coordination with the 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 CAR 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.

13.4. 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.

13.5. 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.
 - allow the EFB operating system and hosted applications to remain "stable" after multiple start-ups and shutdowns.

13.6. 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.

13.7. 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.

13.8. 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.

13.9. 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.

13.10. 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, takeoff, 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.

13.11. 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 CAR 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.

13.12. Special Data Storage and Retrieval Considerations.

- a. The EFB system needs to permit any authorised representative of the CAA or the Aircraft Accident Investigation Bureau (AAIB) to retrieve, view, or print the information contained in any EFB system upon reasonable request. If the CAA or AAIB 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.

13.13. Training

Training should reflect the level of the functionality and complexity as agreed upon by the operator and the CAA. Training should address flight crew and maintenance personnel requirements, as appropriate.

- a. CAA Flight Operations may wish to reference applicable FAA/Industry Training Standards (FITS) to determine the best practices for training and use of the EFB in a manner pertinent to Part 91 operations. Determine the appropriate FITS programme in consultation with the equipment manufacturer and/or CAA Flight Operations.

b. Certificated operators requesting to conduct operations using EFB cockpit applications should use the training guidance to develop a curriculum segment for the EFB system, which may consist of a ground training simulation and, if needed, a flight training segment. The EFB curriculum segment should include an outline of the training, appropriate courseware, and the instructional delivery method. Each EFB training module should include the following elements:

- i. A description of an EFB, its capabilities, and the applications for which the operator will use the EFB system and its components and peripherals. This should include theory of operation and the training should ensure that flight crews understand the dependencies associated with the sources and limitations of the information.
- ii. A description of EFB controls, displays, symbology, and failure modes. EFB failure modes and flight crew procedures should include a description of the EFB system (e.g. EFB signal processor, switches, and installed databases, such as an airport surface or en route moving map). If colour is a significant EFB application feature, then training materials should include colour illustrations.
- iii. An AFMS or other documentation that provides conditions, limitations, and procedures for the use of the EFB system and its associated equipment. For instance, operators should train flight crews on how to ensure that the airport charts and manuals are current, and what to do if they find that the software and/or databases are out-of-date. Only EFB provisions (mounts, wiring, etc.) for Class 2 EFBs, or installation for approved EFBs, require an AFMS, unless approved by TSO. Class 1 and Class 2 EFBs and Type A and Type B EFB applications may require an alternative means of documentation that provides conditions, limitations, and procedures for use.
- iv. Descriptions of authorised special flight maneuvers, operations, and procedures the operator conducts when using an EFB.
- v. Any special pilot/controller procedures when using EFB-based information.
- vi. Geographical areas authorised for specific EFB operations, if applicable.
- vii. Authorised methods to defer inoperative EFB equipment.

c. Operator training should also provide an opportunity for instruction, demonstration, and practice using the actual or simulated EFB equipment and displays. Base the EFB qualification curriculum segment (required for parts 121, 125 and 135 operators) on functionality and complexity as agreed upon by the operator and CAA. In addition, EFB components installed in accordance with applicable airworthiness regulations may contain EFB training guidance in the aircraft Operations Suitability Report.

d. Parts 121, 125 and 135 operators are required to conduct initial fleet training. The CAA will issue a letter authorizing an operator to instruct personnel under the EFB curriculum segment, pending an evaluation of training effectiveness. This also allows CAA inspectors who are responsible for certificate management to become familiar with the operator's EFB system and equipment. After the CAA evaluates the operator's EFB curriculum segment and determines that it is satisfactory, the CAA

issues an interim operational approval to the operator. This authorizes the operator to continue training in accordance with the operator's approved training programme.

13.14. Pilot Training Programme.

a. **Parts 121 and 125 Operators.** Except when under the supervision of an appropriately trained flight examiner, the flight crew may need to complete a training programme approved or accepted by the Director before being authorised to use the EFB equipment. However, flight crew members should have satisfactorily completed the ground school portion of the EFB training programme, if required. Training as outlined in this Advisory Circular is only applicable to those flight crew members that actually operate the equipment. Training is not required of crew members that are not authorised to use the equipment, even though it may be installed in the aircraft, unless it is operated under the supervision of a flight examiner. For air transport operations, initial qualification with the EFB may require that the flight crew members demonstrate satisfactory proficiency with the EFB to a CAA inspector or flight examiner; this may be completed during a line check.

b. **Part 135 Operators.** Although no training programme requirements exist for part 135 operators, the flight crew members should have satisfactorily completed the ground school portion of the EFB training programme before performing under the supervision of a flight examiner or evaluation by an authorised instructor. The CAA may authorise an individual (e.g. the company chief pilot, company flight examiner, or training course provider) to complete this evaluation. The flight crew must have a satisfactory evaluation of their performance in the use of the EFB in flight before using the equipment in normal operations.

c. **Part 91 Operators.** The primary source of operational and training guidance will be provided through the FITS, which can be obtained through the 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.

13.15. 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**

a. 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.

a. The CAA needs to evaluate the actual requirement for a flight test for each request. The 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.

13.16. Need for Approved Manuals

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

13.17. 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, 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 the CAA on airworthiness related considerations to determine the appropriate authorisations necessary for each EFB application.

13.18. 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).

13.19. 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 the CAA.

13.20. User Feedback

Parts 121 and 125 operators should implement a formal process for gathering feedback. Use this process during design, installation, modifications, or improvements to procedures and/or training.

13.21. Paperless Operations Approval.

- a. **Certificated Operators.** An operational approval will be issued and the relevant Op Spec 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 Advisory Circular 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 Advisory Circular, may be substituted for the paper equivalent. It requires no formal operational approval as long as the guidelines of this Advisory Circular are followed.
 - i. Any Type A or Type B EFB application, as defined in this Advisory Circular, 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 aircraft operator and/or PIC is responsible to show compliance with all the requirements of paragraph 0. This should be in written form on-board the aircraft. The EFB system on board must be functionally equivalent to the paper reference material which the information is replacing. The pilot verifies that all information used for navigation, aircraft operation, or performance planning is current, up-to-date, and valid.
 - 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 Advisory Circular. 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.

13.22. 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 Advisory Circular;
- 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. Op Spec 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 takeoff and landing performance calculations).
- Weight and Balance (W&B) manual, if a separate manual (fixed, non-interactive material).
- Other aircraft performance data manuals, including specialized performance data for use in conjunction with advanced wake vortex 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 midair 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.
- Mongolian 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 but without display of aircraft/own-ship position.
- 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 Class 1 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 Advisory Circular (AC) 120-76B, Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices. Note: This AC is currently being revised.

FAA AC 91-78, Use of Class 1 or Class 2 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 advisory circular. For air operator certificate holders, and operational approval via Op Spec 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 Advisory Circular 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 Advisory

Circular. 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.

Note: Class 1 EFBs with Type B software must not display the aircraft's position, also referred to as "own-ship position," in accordance with current policy (see paragraph 0, and Appendix B). The *Jeppesen Mobile TC App* inhibits own-ship position.

Operator Authorisation:

The authorisation process that the CAA uses for certificate holders and programme managers is contained in this Advisory Circular. 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 applicable to portable Class 1 or 2 EFBs. OpSpec. 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 Advisory Circular. 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. AC 91-78 and this Advisory Circular 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 CAR Part 91.7, Portable electronic devices.