澳門特別行政區
REGIÃO ADMINISTRATIVA ESPECIAL DE MACAU
民航局
AUTORIDADE DE AVIAÇÃO CIVIL
CIVIL AVIATION AUTHORITY

AC
No. : AC/OPS/029R01
Date : 01 November 2016

AERONAUTICAL CIRCULAR
CIVIL AVIATION AUTHORITY – MACAO, CHINA

SUBJECT: ***ELECTRONIC FLIGHT BAG***

EFFECTIVE DATE:

15 November 2016

CANCELLATION:

AC/OPS/029R00

GENERAL:

The President of Civil Aviation Authority – Macao, China, in exercise of his power under Paragraph 89 of the Air Navigation Regulation of Macao (ANRM) and Article 35 of the Statutes of Civil Aviation Authority, approved by the Decree-Law 10/91/M, established this Aeronautical Circular (AC).

1. Introduction

In accordance with paragraph 38A of the ANRM, the operator of a Macao registered aircraft shall not permit the use of electronic flight bags on board an aircraft for the purpose of commercial air transport except with the approval of the Civil Aviation Authority for the operational use of EFB functions.

The purpose of this AC is to promulgate requirements and guidelines for the operational approval of Electronic Flight Bag (EFB).

2. Applicability

2.1 This AC is applicable to all Macao Air Operator Certificate (AOC) holders using or intending to use EFB on aircraft for either in preparation for flight or during flight.

2.2 Installed or integrated EFB devices (Class 3) as defined later in this document are considered to be outside of the scope of this AC and their approval should be conducted in accordance with airworthiness certification procedures. For this class of equipment the manufacturer's approved data is to be used as the basis for operational procedures and continuous airworthiness instruction.

3. System Description and Classification of EFB System

This section is divided into two parts. The first part deals with the host platform i.e. the hardware used to run the software application and the second part deals with the software application installed to provide the relevant functionality.

3.1 Hardware Classes of EFB System

3.1.1 Class 1

- Generally Commercial-Off-The-Shelf (COTS) based computer systems used for aircraft operations.
- Portable.
- Not attached to an aircraft mounting device.
- Can be attached to the pilot's leg (e.g. kneeboard type).
- Can be temporarily connected to an existing aircraft power supply for battery recharging.
- Without aircraft data connectivity.
- May not be used as navigation devices and the ship's own position should not be displayed.
- Class 1 EFB systems do not require airworthiness approval.

3.1.2 Class 2

- Generally Commercial-Off-The-Shelf (COTS) based computer systems used for aircraft operations.
- Attached to a mounting device permanently attached to aircraft structure and/or connected to aircraft systems.
- Connect to aircraft power through a certified power source.
- Connectivity to Avionics is possible.
- May not be used as navigation devices and the ship's own position should not be displayed.
- Class 2 EFB systems require airworthiness approval. However, this approval is limited in scope to the mounting device, crashworthiness, data connectivity and EFB power connection.

3.1.3 Class 3

- This category of EFB is fully integrated into the aircraft flight compartment and aircraft system, usually referred to as installed EFB systems and is part of the aircraft type design, which requires airworthiness approval via Type Certificate or Supplemental Type Certificate.

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
Tel.: (853) 28511213 • Fax: (853) 28338089 • AFTN: VMMCYAYX • E-mail: aacm@aacm.gov.mo

3.2 Software Application Classes of EFB System

3.2.1 Type A

Type A software application is non-interactive material such as manuals, weight and balance documents (not calculators) and logs.

- May be hosted on any hardware classes.
- Do not require airworthiness approval.
- Pre-composed, fixed presentations of data currently presented in paper format, provided operations do not require its use during critical phase of flight.
- Primarily intended for use during flight planning, on the ground or during non-critical phases of flight.
- Malfunction of a Type A software 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.

3.2.2 Type B

Type B software application includes more sophisticated software application such as performance and weight-and-balance calculating software application, dynamic interactive electronic aeronautical charts but without display of airborne aircraft/own-ship position, data link weather and so on.

- May be hosted on any hardware classes.
- Do not require airworthiness approval.
- Primarily intended for use during flight planning and all phase of flight.
- Can be used on all phases of flight provided it is hosted on a Class 2 or installed EFB.

Note: Particular attention must be given to the Type B software that provides interactive performance calculation, aim to minimize possibility of a user to fail to notice an inappropriate item of data on switching back on after switch-off, as all required fields will be populated with data from the previous calculation.

3.2.3 Type C

- *See Appendix A of this AC.*

4. EFB System Evaluation Criteria

4.1 When evaluating an EFB the following items should be considered:

4.1.1 Stowage - Stowage need only be considered for Class 1 units as Class 2 devices are by definition mounted to the aircraft. If it is contemplated that Class 2 unit may be removed from their mounting during flight operations then stowage considerations would also apply in this case.
A stowage area with a securing mechanism for these EFBs are recommended for storage of portable units when they are not in use. Stowage provisions should be readily accessible by the crew in flight and should not cause any obstruction or hazard during foreseeable aircraft operations. EFB systems that are not secured in a mounting device during use should be designed and used in

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
Tel.: (853) 28511213 • Fax: (853) 28338089 • AFTN: VMMCYAYX • E-mail: aacm@aacm.gov.mo

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.

4.1.2 Cabling - Certification is required for any cabling associated with Class 2 EFB. The cabling should not hang loosely in a way that compromises task performance or safety. Flight crew members should be able to easily secure cables out of the way during aircraft operations. Cables should be of sufficient length to perform the intended function. Cables too long or too short could present an operational or safety hazard.

4.1.3 Mounting Provisions - This paragraph applies to Class 2 EFBs only, mounting provisions must be approved by AACM and must meet all the applicable certification requirements. The mounting device (or other securing mechanism) that attaches or allows mounting of the EFB system should ensure that the EFB is positioned in a way that it does not obstruct visual or physical access to aircraft controls and/or displays, flight crew member ingress or egress, or external vision. The design of the mount should allow the user easy access to the EFB controls and a clear view of the EFB display while in use. The following design characteristic should be considered:

(i) The mount and associated mechanism should not impede the flight crew member 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.

(iii) A provision 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) An unsafe condition must not be 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 equipment when mounted and/or installed should not present a safety-related risk or associated hazard to any flight crew member. A means to store or secure the device when not in use should be provided. 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.

(v) If it has a stowed position, the EFB should be easily accessible when stowed. When the EFB is in use and is intended to be viewed or controlled, it should be within 90 degrees on either side of each pilot‘s line of sight.

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
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(vi) Reflection - In the position in which it is intended to be used, the EFB should not produce objectionable glare or reflections that could adversely affect the pilot‘s visual environment.

4.1.4 Lighting - 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 automatic brightness adjustment is incorporated, it should operate independently for each EFB in the flight deck. Buttons and labels should be adequately illuminated for night use. Consideration should be given to the long-term display degradation as a result of abrasion and aging.

4.1.5 Readability - 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.
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. This should be evaluated based on the software application and intended operational function. If there is a cursor, it should be visible on the screen at all times while in use.
If the electronic document/ software application supports multiple open documents, or the system allows multiple open software application, indication of which software application and/or document is active should be continuously provided. 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 software application or documents is currently active. In addition, the user should be able to find which flight deck software applications are running and switch to any one of these software applications easily. When the user returns to a software application that was running in the background, it should appear in the same state as when the user left that software application—other than differences associated with the progress or completion of processing performed in the background.

4.1.6 Controls - All controls should be properly labeled for their intended function, and should be within reach of the appropriate crewmember seated normally on the flight deck. In choosing and designing input devices such as keyboards or cursor-control devices, applicants 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 should be tailored for the intended software application function as well as for the flight deck environment.

4.1.7 Disabling of EFBs - There should be a means other than a circuit breaker to disable the EFB in the event of unwanted operation such as continuous flashing. Circuit breakers may not be used as switches.

4.1.8 Electromagnetic Interference Demonstration - Class 1 and Class 2 EFB systems should demonstrate that they meet appropriate industry adopted environmental

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
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qualification standards for radiated emissions for equipment operating in an airborne environment. Any Class 1 or Class 2 EFB used in aircraft flight operations should be demonstrated to 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. Guidance for conducting interference testing may be found in RTCA DO-160.

4.1.9 Rapid Depressurization Testing - Determining an EFB device's functional capability requires rapid decompression testing when utilizing Type B software application in pressurized aircraft, unless alternate procedures or a paper backup is available. When using only Type A software application 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.

4.1.9(a) Pressurized Aircraft - It is necessary to conduct rapid decompression testing for Class 1 and/or Class 2 EFB devices when the EFB has Type B software application and/or is used to remove paper-based aeronautical information in a pressurized aircraft in flight.

4.1.9(b) Un-Pressurized Aircraft - Rapid decompression testing is not required for a Class 1 or Class 2 EFB used in an un-pressurized 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.

4.1.10 Responsiveness of Software application - The system should provide feedback to the user when 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 software application's intended function. The feedback and system response times should be predictable to avoid flight crew distractions and/or uncertainty.

4.1.11 Ease of Use - EFB software application should be designed to minimize flight crew workload and head-down time. Complex, multi-step data entry tasks should be avoided during take-off, landing, and other critical phases of flight.

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
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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 an EFB is to be used 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.

4.1.12 Technical Support for hardware and software application -Ensure a reliable manpower to backup operator's operations when needed.

4.1.13 SMS Interface-Ensure that EFB hazard analysis, risk assessment, and related safety reports are incorporated into the operator's Safety Management System (SMS).

4.1.14 Battery Considerations, operator shall address:

(a) Risk of leakage of the batteries

(b) Safe storage of spare batteries including the risk for an inadvertent short circuit, hazard due to continuous charging of an on-board-device including battery overheat, current regulations regarding carriage spare battery on-board an aircraft not installed in the EFB still apply.

(c) Responsibility of the operator for the maintenance of EFB-System battery, their periodical checking and appropriate replacement. In the case of the EFB manufacturer has not specified a battery replacement interval, then the original battery manufacturer's specified replacement interval should be adhered to.

(d) As a minimum specification, the lithium battery incorporated within the EFB device should have been tested to meet either one of the following standards;

- Underwriters Laboratories (UL). UL 1642, Lithium Batteries; UL 2054, Household and Commercial Batteries; and UL 60950-1, Information Technology Equipment - Safety;
- International Electro technical 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 devices;
- 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
- RTCA/DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems.

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
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5. The EFB Policy and Operational Procedures

The EFB Policy and Procedures is part of the EFB evaluation criteria, it should address the validity and currency of EFB content and the source, thus ensuring the integrity of EFB data. The EFB Policy and Procedures can be part of the Operator's Operations Manual; these procedures may include, but is not limited to the following:

5.1 Introduction
- 5.1.1 Glossary of Terms, Definitions and Acronyms
- 5.1.2 Hardware Description
- 5.1.3 Operating System Description
- 5.1.4 Software Application Description

5.2 Hardware and Operating System Control and Configuration
- 5.2.1 Purpose and scope
- 5.2.2 Hardware Configuration Procedures
- 5.2.3 Operating System Configuration and Control Procedures
- 5.2.4 Accessibility Control Procedures
- 5.2.5 Hardware Maintenance Procedures
- 5.2.6 Operating System Updating Procedures

5.3 Software Application Control and Configuration
- 5.3.1 Purpose and scope
- 5.3.2 Software Application Configuration Procedures
- 5.3.3 Software Application Updating Procedures
- 5.3.4 Procedures to avoid corruption/errors during changes to the EFB system

5.4 Flight Crew Operating Procedures
- 5.4.1 Designated EFB storage locations
- 5.4.2 Preflight procedures
- 5.4.3 Normal cockpit procedures
- 5.4.4 Phase of flight procedures
- 5.4.5 Contingency or abnormal procedures
- 5.4.6 Post flight procedures
- 5.4.7 Storage of EFB other than during flight
- 5.4.8 Appropriate use of EFB policy
  Operator should define the intended uses of the EFB including unacceptable uses and the consequences for non-compliance, a review to this policy shall be done periodically to account for advances in technology and regulations change.
- 5.4.9 Reporting unintended, contingent, or abnormal use
- 5.4.10 EFB Discrepancy Report
- 5.4.11 EFB Substitution/ Use in More Than One Aircraft (If applicable)
  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 replaced EFBs are approved for use by the AACM.

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
Tel.: (853) 28511213 • Fax: (853) 28338089 • AFTN: VMMCYAYX • E-mail: aacm@aacm.gov.mo

5.4.12 Multiple EFB
In case of multiple EFBs on the flight crew compartment, procedures to ensure that they all have the same content/databases installed.

5.4.13 Placard Procedure
Interface with the MEL procedure that is specific to the aircraft type or registration number, if applicable.

5.4.14 MELs
As required by the regulations, operators shall update their MELs to reflect the installation of EFB. MEL relief is amended in compliance with the aircraft's Master Minimum Equipment List (MMEL).

5.5 Quality Assurance and Security
- 5.5.1 A description of the security policy
- 5.5.2 A general description of the handling and exposure of hardware and software application components
- 5.5.3 Instructions in the handling of access rights and passwords
- 5.5.4 Instruction, how the securing of hardware shall take place within the operation
- 5.5.5 Information concerning Data corruption and protection
- 5.5.6 Explanation on preventive use of dedicated Hard Disk Drive partitions.

5.6 User Feedback Procedures
Operator shall have a feedback/correction process that ensures the reliability of the data. The data collection processes in place should be factored into the operator's Safety Management System (SMS).

5.7 EFB Training Program
- 5.7.1 Initial Training Curriculum and Completion Standards
- 5.7.2 Recurrent Training Curriculum and Completion Standards
- 5.7.3 Instructor Qualifications
- 5.7.4 Checking
- 5.7.5 Records of Training

5.8 Appendix-List of current EFB software applications
This section should match the section 3 of the EFB use operational approval application on file with AACM.

6. Five Phases Operational Approval Process

The operator is responsible to ensure that all operational requirements are met for an EFB. The operator must submit documentation demonstrating compliance with all operational requirements for EFBs to the AACM.

6.1 Phase I—Initiation. Phase one of the process begins when the operator requests approval to use the EFB from the AACM in writing. During this phase, the AACM and the operator reach a common understanding of the role of the AACM and what documents and actions the operator is responsible for during each phase of the approval process.

6.2 Phase II—Required application Information. Phase two begins when the operator submits a formal EFB implementation plan to the AACM for evaluation. The plan is reviewed for completeness. Once the plan is accepted, the operator follows that plan to produce a complete EFB program. The operator must submit the following information in the application package:

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
Tel.: (853) 28511213 • Fax: (853) 28338089 • AFTN: VMMCYAYX • E-mail: aacm@aacm.gov.mo

- EFB hardware and software application specification
- The EFB policy and operational procedures as described in Section 5 of this AC.
- Rapid Decompression test data (if applicable)
- Completed non-interference test results
- Airworthiness approval documents for Class 2 EFB (mounting device, aircraft data connection, power supply, crashworthiness).
- Risk Assessment report for the use of EFB on board
  Applicant is required to demonstrate that the use of EFB has been subject to a risk assessment conducted under the operator's Safety Management System (SMS). Such assessment is to ensure that, safety risk(s) associated with each EFB functions are assessed. In the event of an EFB failure, sufficient information is readily available to the flight crew for the flight to be conducted safely.

Note: Training program must be approved by the AACM prior to the start of any training.

6.3 Phase III—In-Depth Review. In this phase, AACM will examine the technical content and quality of the proposed EFB program and other supporting documents and procedures. At the AACM's discretion, when an operator is requesting initial EFB approval, a simulator evaluation or flight evaluation of an EFB may be required. Additional simulator or flight evaluations are not required for adding a new EFB to an existing approval unless there is a substantial change in EFB intended functions. When a new aircraft is added to a certificate with existing EFB approval, the aptness of the EFB for that aircraft must be addressed as part of aircraft conformity and configuration control process.

6.4 Phase IV—6-month Operational Validation Testing. An interim EFB approval is granted to allow the operator to proceed with the required EFB 6-month operational validation testing. During validation testing, the operator must maintain a paper backup of all electronic information. The 6-month validation test formally begins when the temporary authorization is issued to the operator, the 6-month period dedicated to this test should take the frequency of the flights into account. Within the validation period, operator may be asked to submit a performance report to the AACM every 30 days.

- **Unacceptable Validation Results.** If AACM finds the proposed EFB reliability and/or function to be unacceptable by the conditions of this AC, then the AACM should contact the operator for corrective action. EFB deficiencies must be corrected and the EFB function revalidated before proceeding to phase five.
- **Acceptable Validation Results**. If at the completion of the EFB 6-month validation test, the AACM finds the proposed EFB reliability and/or function to be acceptable based on validation data, then operator can proceed to phase five of the EFB approval process.

6.5 Phase V—Authorization to Use an EFB. The operator is granted authorization to use an EFB through the issue of Operations Specifications after acceptable completion of validation testing in phase four. This approval is limited to the hardware and software application that were submitted in Phase Two. Any subsequent change to EFB hardware, software application which alters intended functions will void the current approval; in such case, a written request for re-approval to the AACM is required.

– END –

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
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Appendix A – Type C Classification

The list below includes software application that are considered by the AACM to be ineligible for classification as either Type A or B software application and will need to go through a full airworthiness approval process: [1] & [2]

- Any software application displaying information which may be directly used by the flight crew to control aircraft attitude, speed, altitude (e.g., PFD type of display). [3]
- Any software application displaying information which may be directly used by the flight crew to check or control the aircraft trajectory, either to follow the intended navigation route or to avoid adverse weather, obstacles or other traffic, in flight or on ground. Moving maps, or presentation of weather maps, terrain, and other aircraft positions relative to ownship's position could fall into this category if accuracy, refresh rate and resolution are sufficient.
- Any software application displaying information which may be directly used by the flight crew to assess the status of aircraft critical and essential systems status, and/or to manage aircraft essential and critical systems following failure. [3]
- Any software application enabling primary means of communications related to air traffic services, or whereby the flight path of the aircraft is authorized, directed or controlled.
- Any software application substituting or duplicating any certified avionics systems.
- Software application which due to automatic interactions with other aircraft systems, displays and controls would raise significant human factors issues.

Remarks:

[1] Software application covered by an airworthiness approval may contain user-modifiable software application or data. The boundaries of the user-modifiable parts should be defined as part of the airworthiness approval.

[2] In case of doubt on the applicability of the above criteria, the software application developer should contact the responsible authority and seek advice.

[3] The wording "may directly be used by the flight crew" in the above criteria is intended to assess the potential use by the crew considering the functional capability of the software application.

Alameda Dr. Carlos D'Assumpção, 336-342, Centro Comercial Cheng Feng, 18° andar - Macao
Tel.: (853) 28511213 • Fax: (853) 28338089 • AFTN: VMMCYAYX • E-mail: aacm@aacm.gov.mo