Technical Airworthiness Authority – Operational Airworthiness Authority Advisory (TAA-OAA Advisory)	
Title	**Obtaining Technical Airworthiness Clearance and Operational Airworthiness Clearance for Portable Electronic Flight Bags**
Advisory Number	**2012-01-v3 (Revised March 2021)**
Effective Date	**1 May 2018**
Reference	**TAM, Part 2, Chapter 3 and Part 3, Chapter 2** **OAM, Chapter 3, Paras 314 and 315**
OPI/Telephone	**DTAES 6-4 / 819-939-4714** **SSO OA / 204-833-2500, ext. 6649**
RDIMS File	**2182D-1027-812-6 – VOL 1** **AEPM #1708151 (English)** **AEPM #1796709 (French)**

1. Purpose

1.1 The purpose of this joint Technical Airworthiness Authority (TAA) – Operational Airworthiness Authority (OAA) Advisory is to provide guidelines for obtaining initial and follow-on Technical Airworthiness Clearance (TAC) and Operational Airworthiness Clearance (OAC) for Portable Electronic Flight Bags (EFBs).

2. Applicability

2.1 This joint TAA-OAA Advisory is applicable to organizations involved with the TAC and OAC of portable EFBs.

2.2 This joint TAA-OAA Advisory only addresses Portable EFBs. Portable EFBs are those brought on board by the flight crews and are not part of the configuration of the type certified aircraft. Any reference to an EFB in this advisory means a Portable EFB.

Notes

1. *Installed EFBs are considered permanent and fully integrated within the aircraft flight deck. An example of an Installed EFB would be a modern aircraft with a certified Multi-Function Display (MFD), where that MFD includes the capability to display Aeronautical Charts.*
2. *Approval of Installed EFBs is covered by existing DND/CAF Design Change policy covering permanent installation of avionic equipment and not included as part of this advisory*.

2.3 EFBs should not be used to replace any functions (e.g., navigation, surveillance, etc.) currently provided by certified aircraft systems and will not be granted airworthiness approval for such functions. EFBs should only carry copies of approved airworthiness data/documentation (e.g., AFM/AOI, approach plates, checklists, etc.).

2.4 The *Operational Airworthiness Manual* (regulatory reference 3.2.c), Chapter 3, Paragraph 314 provides the following regulatory requirements for Portable Electronic Devices (PEDs):

"If a PED is required by aircrew for the conduct of official airborne duties, it is no longer considered a PED, but is now an aeronautical product, and must be cleared for use IAW the airworthiness clearance process. Even if a PED has been recommended for an unrestricted electromagnetic compatibility (EMC) safety of flight (SOF) clearance, a technical and operational clearance is still required – to ensure that the PED does not interfere with fleet-specific aircraft systems (including egress) and that the aircrew are properly trained to use the PED and to store it when not in use."

2.5 A TAC and an OAC or an Operational Airworthiness Approval (OA Approval) will be required prior to using EFBs operationally.

3. Related material

3.1 Definitions

a. **Electronic Flight Bag (EFB)**. An electronic display system intended primarily for cockpit or cabin use. EFB devices can display a variety of aviation data or perform calculations, such as performance data and fuel calculations. In the past, some of these functions were traditionally accomplished using paper references, or were based on data provided to the flight crew by base operations. The scope of the EFB functionality may also include various other hosted databases and applications. Physical EFB displays may use various technologies, formats and forms of communication. In the context of this TAA-OAA Advisory, an EFB includes both the hardware and software needed to support an intended functionality.

b. **EFB Administrator.** The person appointed by the Operational Commander to be held responsible for the administration of the EFB system within the Fleet or Wing. The EFB Administrator will be the person in overall charge of the EFB system and will be responsible for ensuring that the hardware conforms to the required specification, and that no unauthorized software is installed. This person will also be responsible for ensuring that only the current version of any application and data packages are installed on the EFB system.

c. **Type A EFB Software Applications**. Software installed on an EFB providing a specific operational functionality, whose malfunction or misuse would have no adverse effect on the safety of any flight operation, that is a failure condition classification considered to be "no safety effect" (refer to Annex A of this TAA-OAA Advisory).

d. **Type B EFB Software Applications.** Software installed on an EFB providing a specific operational functionality, whose malfunction or misuse would have a "minor" or "less than minor" failure condition classification (refer to Annex B of this TAA-OAA Advisory).

e. **Viewable stowage device**. A portable device or component used to secure an EFB, viewable to the pilot (e.g., kneeboards, suction cups, etc.).

3.2. Regulatory References

a. AF9000 procedure EMT04.057 – *Design Change Certification Process;*

b. C-05-005-001/AG-001 – *Technical Airworthiness Manual* (TAM);

c. B-GA-104-000/FP-001 – *Operational Airworthiness Manual* (OAM);

d. ICAO *Manual of Electronic Flight Bags (EFBs)* Doc 10020, Second Edition – 2018;

e. AF9000 procedure EMT04.059 – *Airworthiness Approval, Technical Approval and Technical Airworthiness Clearance of Non-Installed Equipment*;

f.C -05-005-044/AG-001 – *Electromagnetic Environmental Effects (E3) Control within the Canadian Forces (Air)*;

g. TAA Advisory 2015-02 – *Demonstrating Aircraft E3 Tolerance to Portable Electronic Devices*;

h. C-05-005-001/AG-002 – *Airworthiness Design Standards Manual,* Part 2, Chapter 6, "Aircraft Cybersecurity";

i. RCAF *Flight Operations Manual (FOM)*, 2.2.8, Part 8 – Electronic Flight Bags;

j. Federal Aviation Administration (FAA) *Safety Alert for Operators* (SAFO) 09013 with subject: "Fighting Fires Caused by Lithium Type Batteries in Portable Electronic Devices", dated 23 June 2009.

k. Technical Manual for Batteries, Navy Lithium Safety Program Responsibilities and Procedures S9310-AQ-SAF-010 (available internally, within DND, at AEPM RDIMS #2065530).

4 Discussion

4.1 Background

4.1.1 EFBs perform a variety of functions, traditionally accomplished using paper references, by electronically storing and retrieving documents required for flight operations, such as the AFM, AOI, Standard Manoeuvers Manual (SMM), Checklists, Minimum Equipment Lists (MEL), and Enroute, Terminal and Approach Charts. As such, EFBs may be authorized for use in conjunction with, or as replacement for, some of the hard copy material that aircrew would typically carry in their flight bags. This EFB functionality is derived by hosting either Type A or B software applications on a portable EFB. EFB software applications that cannot be categorized as Type A or Type B (i.e., not listed in Annex A or B, or whose malfunction or misuse would have a "major" or greater failure condition) cannot be authorized under the guidance of this advisory.

4.1.2 EFB applications have also been developed to support functions during all phases of ground and flight operations. Numerous applications are available, with varying degrees of complexity.

4.1.3 While EFBs are not to be authorized for use as a certified navigation system, it is recognized that their use for situational awareness purposes provides improved safety of flight. Therefore, the use of own-ship position for situational awareness purposes may be authorized by the OAA.

4.1.4 The EFB may have wired or wireless aircraft data connectivity, provided it is shown that the EFB does not negatively impact the safe operation of the aircraft. The wired and/or wireless aircraft provisions that support the EFB to aircraft data connectivity are a design change that will require airworthiness approval (see paragraph 4.2.1.2.b.)

4.1.5 The EFB may be powered from an internal battery, or powered/recharged through a certified aircraft power source.

4.2 TAC and OAC Aspects

4.2.1 **Technical Airworthiness Clearance (TAC)**

4.2.1.1 The TAC process is documented in reference 3.2.b. Aspects associated with granting a TAC for EFBs can be addressed in accordance with existing approved processes. The TAC covers items that require airworthiness approval, and those that do not.

4.2.1.2 The implementation aspects requiring airworthiness approval in support of a TAC (as applicable to the proposed implementation) include the following:

a. Electromagnetic Environmental Effects (E3);

b. Design changes that require modification(s) to the aircraft in support of the EFB (e.g., mounting provisions, electrical and interface wiring provisions, data connectivity provisions);

c. Stowage;

d. Human Factors, as they pertain to affecting the already existing certified aspects of the aircraft (e.g., blocking view of required flight instruments, impeding egress and, where applicable, safe ejection, etc.); and

e. Aircraft systems and network security for wired or wireless connections to aircraft systems (acceptable guidance is provided in reference 3.2.h).

4.2.1.3 For convenience, the aspects in 4.2.1.2 relating to airworthiness approval are included in the Annex D checklist of this TAA-OAA Advisory and annotated as **[CERT].**

4.2.2 **Operational Airworthiness Clearance**

4.2.2.1 The OAA is responsible for assessing the operational suitability and functionality requirements associated with the operational use of the EFB and for issuing an associated OAC. The OAC process is documented in reference 3.2.c.

4.2.2.2 The OAA has published an amendment to the RCAF FOM (reference 3.2.i), aimed at providing direction on the use of EFBs in RCAF training and operations.

4.3 Electronic Flight Bags Implementation Procedures

4.3.1 Fleets incorporating EFBs into their operations should carefully review the contents of this TAA-OAA Advisory to determine applicable requirements. For the most part, the level of complexity associated with the operational implementation will depend on whether aircraft design changes will be required to support the EFB, the type of software used and the intended use (e.g., replace all paper approach charts with electronic charts in all phases of flight).

Note

Follow-on changes to the EFB hardware and/or software should be assessed in accordance with the applicable requirements of this advisory.

4.3.2 The operational implementation will require a structured sequence of events to ensure that the aircraft equipped with one or more EFBs can be operated safely. Checklists are provided in the appendices to this TAA-OAA Advisory to assist with the evaluation of the TAC and OAC aspects of EFBs.

4.3.3 Depending on circumstances, the TAC and OAC aircraft evaluations may be carried out separately or as a combined exercise.

Note

On-aircraft evaluations carried out in support of checklist completion (e.g., cockpit compatibility, assessment of operational suitability and effectiveness) are normally carried out by Test and Evaluation (T&E) Agents in accordance with the Flight Test Orders for the Canadian Forces (C-05-020-007/AM-000). The requirement for on-aircraft evaluation is identified by Finding Authorities (for Airworthiness Approval), Technical Authorities and staff holding Operational Airworthiness authority.

4.3.4 From a process perspective, it is envisaged that the Fleet and/or WSM will:

a. determine the required EFB capability and mission usage (e.g., CONOPS [1 CAD]);

b. decide on the type of EFBs to use, based on a number of factors, including the use of this TAA-OAA Advisory [1 CAD];

c. complete all necessary assessments, evaluations, document updates, training, maintenance schedule changes, etc. [WSM/1 CAD];

d. process TAC in accordance with the requirements of the TAM, relevant Engineering Process Manual (EPM) and associated procedures (e.g., AF9000 EMT 04.057 – Design Change Certification Process (reference 3.2.a), AF9000 EMT 04.059 for Non Installed Equipment (reference 3.2.e), etc.) or relevant contractual requirements, as applicable [WSM/PMO];

e. fulfill the requirements in the RCAF FOM 2.2.8, Part 8 (reference 3.2.i) [1 CAD]; and

f. submit AFM/AFM-AOI amendments, if applicable [WSM/1 CAD].

4.3.5 Technically-oriented evaluations are required as detailed in Annexes C, D and E of this TAA-OAA Advisory. Those TAC aspects requiring airworthiness approval are annotated "**[CERT]**" in Annex D.

4.3.6 Operational evaluations are required as detailed in Annexes F, G, H and I of this TAA-OAA Advisory.

4.3.6.1 The first evaluation detailed in Annex F of this TAA-OAA Advisory is to ensure that Fleets have properly addressed the CAF implementation of EFBs from an organizational process perspective. The associated evaluation checklist is provided in Annex G of this TAA-OAA Advisory.

4.3.6.2 The second evaluation detailed in Annex H of this TAA-OAA Advisory is an aircraft-level operational evaluation, which would normally be conducted by the Operational Test and Evaluation community. An associated operational evaluation checklist is provided in Annex I of this TAA-OAA Advisory. Depending on the circumstances, this evaluation may be combined with the evaluation detailed in Annex C of this TAA-OAA Advisory.

4.3.7 Fleets procuring, developing or contracting the development of EFB Software Applications should consult Annex J – *Guidance for the Development of EFB Software Applications.* Annex J contains best practices associated with the development of certain categories of EFB Type B applications. Since the software applications reside on a portable EFB, and are not part of the aircraft Type Design, the responsibility for the assessment of these software applications resides with the OAA. DTAES would be able to provide assistance with these assessments through an Engineering Support (ES) tasking, if requested to do so. The OAA should direct requests for ES to DTAES 6.

DESCRIPTION AND EXAMPLES OF "TYPE A" SOFTWARE APPLICATIONS

1. Type A Software Applications:
   a. do not substitute for, or replace, any paper, system functionality or equipment required by the technical or operational airworthiness regulations;
   b. do not require compliance with RTCA DO-178() – *Software Considerations in Airborne Systems and Equipment Certification;*
   c. are to be evaluated in accordance with the guidance provided in Annex C of this advisory, Section 3 – Software Application Evaluation; and
   d. require an OAC or OA prior to use.

2. Below is a non-exhaustive list of examples of Type A EFB Software applications:
   a. Aircraft Maintenance Manuals;
   b. Aircraft flight log and servicing records;
   c. Service bulletins/published Airworthiness Directives, etc.;
   d. Airport-specific rules and regulations;
   e. Airport/Facility Directory (A/FD) data (e.g., fuel availability, land-and-hold-short operations (LAHSO) distances for specific runway combinations, etc.); Canada Flight Supplement (CFS) in Canada;
   f. Airport diversion policy guidance, including a list of Special Designated Airports and/or approved airports with emergency medical service (EMS) support facilities;
   g. Flight Management System/Flight Management and Guidance System problem report forms;
   h. Aircraft parts manuals;
   i. Required VHF Omni-directional Range (VOR) check records;
   j. Noise abatement procedures for arriving and departing aircraft;
   k. Published (graphical) pilot Notices to Airmen (NOTAM);
   l. International Operations Manuals, including regional supplementary information and International Civil Aviation Organization (ICAO) differences;
   m. Aeronautical Information Publications (AIP);
   n. Aeronautical Information Manual (AIM); and
   o. Flight crew qualification logs.

ANNEX B
TO TAA-OAA ADVISORY 2012-01
DATED 1 MAY 2018
(REVISED IN MARCH 2021)

DESCRIPTION AND EXAMPLES OF “TYPE B” SOFTWARE APPLICATIONS

1. Type B Software Applications:
   a. do not substitute for, or replace, any system functionality required by airspace requirements, technical airworthiness or operational regulations;
   b. may substitute for or replace paper products;
   c. do not require compliance with RTCA DO-178 – *Software Considerations in Airborne Systems and Equipment Certification*;
   d. may include dynamic, interactive applications that can manipulate data and the presentation of that data;
   e. may display own-ship position for situational awareness purposes;
   f. are to be evaluated in accordance with the guidance provided in Annex C of this advisory, Section 3 – Software Application Evaluation; and
   g. require an OAC.
2. Below is a non-exhaustive list of examples of Type B EFB Software applications:
   a. Approved Flight Manuals (AFM), Supplements, Temporary Revisions;
   b. Aircraft Operating Instructions (AOI), Flight Crew Operating Manuals (FCOM);
   c. Standard Manoeuvre Manuals (SMM), Standard Operating Procedures (SOP);
   d. Aircraft performance data (fixed, non-interactive material for planning purposes);
   e. Airport performance restrictions manual (such as a reference for take-off and landing performance calculations);
   f. Other aircraft performance data, including specialized performance data for use in conjunction with advanced wake vortex modeling techniques, LAHSO predictions, etc. (fixed, non-interactive material for planning purposes);
   g. Aircraft performance calculation application that uses algorithmic data or calculates using software algorithms to provide:
      (1) take-off, enroute, approach and landing, missed approach, etc. performance calculations providing limiting masses, distances, times and/or speeds (e.g., runway limiting performance calculations);
      (2) power settings, including reduced take-off thrust settings;
      (3) mass and balance calculation application used to establish the mass and centre of gravity of the aircraft, and to determine that the load and its distribution is such that the mass and balance limits of the aircraft are not exceeded.
   h. (Master) Minimum Equipment Lists ((M)MEL);
   i. Master flight plan/updating;
   j. Interactive Plotting for Class II navigation;
   k. Weight and balance calculations;
   l. Non-interactive electronic approach charts in a pre-composed format from accepted sources;
   m. Panning, zooming, scrolling and rotation for approach charts;
   n. Pre-composed or dynamic interactive electronic aeronautical charts (e.g., enroute, area, approach, and airport surface maps) including, but not limited to: centering and page turning; and own-ship position for situational awareness purposes;
   o. Interactive electronic checklists, including normal, abnormal and emergency (see the current version of FAA AC 120-64 – *Operational Use and Modification of Electronic Checklists*, for additional guidance). EFB electronic checklists cannot be interactive with other aircraft systems;
   p. Weather and aeronautical data;
   q. Airport moving map display (AMMD); and
   r. Applications that make use of the Internet and/or other Aircraft Operational Communications (AOC).

ANNEX C
TO TAA-OAA ADVISORY 2012-01
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PORTABLE ELECTRONIC FLIGHT BAG EVALUATION PROCESS

1. Introduction

1.1. This appendix provides details of the evaluation process required prior to the use of EFB hardware and/or software on an aircraft. The associated checklists are provided in advisory Annexes D and E, respectively. If multiple software applications are being assessed, an Annex E checklist needs to be completed for each one.

2. Hardware

2.1 Stowage

2.1.1 The EFB shall be stowed during critical phases of flight, unless used with an approved mounting device or acceptable viewable stowage device.

2.1.2 Stowage requires an inherent means to prevent unwanted EFB movement. EFB stowage is required for all EFBs not secured in or on a mounting device. If an EFB mounting device is not provided (via viewable stowage or permanently installed mounts), then a verification must be performed to ensure that a suitable area has been designated to securely stow the EFB. This area must prevent the device from jamming flight controls, damaging flight deck equipment, or injuring flight crew members, in the event that the device moves about because of turbulence, maneuvering, or other action. The stowage area should not obstruct visual or physical access to controls and/or displays, flight crew ingress or egress, or external vision. For example, acceptable stowage locations for an EFB with no mount include the inside compartments of the pilot's stowed flight bag.

2.2 Viewable Stowage Devices and Components

2.2.1 Viewable Stowage Devices and Components include items used to secure EFB hardware, which is viewable to the pilot (e.g., kneeboards, suction cups, removable trays, etc.). Viewable stowage devices and components must not interfere with flight control movement; obstruct visual or physical access to controls and/or displays, or flight crew ingress or egress. Viewable stowage should minimize blockage of the windshields to allow the pilots to maintain a clear view of critical outside references (e.g., during ground operations, taxiing, takeoff, approach and landing). Training and procedures should address specific and acceptable placement of viewable stowage devices.

2.2.2 With respect to the use of suction cups, training on the following best practices and procedures is recommended:

a. The suction cups and surfaces to which they will be attached should be properly cleaned with isopropyl alcohol or aircraft window cleaner prior to attachment of the suction cups;
b. Attachment surfaces should be substantially smooth and flat;
c. Periodic cleaning and reattachment should be performed, as appropriate, for the conditions of the environment in which they are used (e.g., dusty);
d. Suction cups should not be left attached to the aircraft windscreens for long periods of time;
e. Suction cups should be replaced every six months, at a minimum, and more often, in extreme environments.

2.3 Cabling

2.3.1 Certification is required for any cabling that interfaces with the aircraft. 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 that are too long or too short could present an operational or safety hazard.

2.4 Data Connections

2.4.1 EFB systems may have data connectivity (wired or wireless) to other aircraft systems. The design of the interface should ensure that there is no possibility of the EFB adversely affecting the aircraft systems from which data is being acquired.

2.4.2 When connected to other aircraft data buses and/or communication systems, EFB operation and/or system failures should not adversely affect other installed aircraft systems.

2.4.3 When an EFB is connected (Wired/Wireless) to aircraft systems, aircraft systems and network security should be assessed in accordance with reference 3.2.h.

2.5. Mounting Provisions

2.5.1 Permanent mounting provisions and viewable stowage devices must meet all applicable certification requirements.

2.5.2 When utilizing permanent mounting provisions and/or viewable stowage devices, a verification should be performed to ensure that the EFB is positioned in a way that does not obstruct visual or physical access to aircraft controls and/or displays, flight crew member ingress or egress, or external vision. The design should allow the user easy access to the EFB controls and a clear view of the EFB display while in use. The following design practices should be considered:

a. 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.

b. Mounts 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 the user's 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. This includes the appropriate restraint of any device, when in use and under any foreseeable operating conditions.

c. 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.

d. 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 (this may require a quick disconnect capability from power and data sources).

2.6 Position

2.6.1 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.

2.6.2 The evaluation needs to consider the potential for confusion that could result from the presentation of relative directions, when the EFB is positioned in an orientation inconsistent with that information. For example, when displaying own-ship position, it may be misleading if the aircraft track is pointed to the top of the display and the display is not aligned with the aircraft longitudinal axis.

2.7 Reflection

2.7.1 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.

2.8 Lighting

2.8.1 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.

2.9 Readability

2.9.1 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.

2.10 Controls

2.10.1 All controls should be properly labelled for their intended function.

2.10.2 All controls should be within reach of the appropriate crew member seated normally on the fight deck.

2.10.3 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 application function, as well as for the flight deck environment.

2.11 Electrical Power Source

2.11.1 EFB implementation should consider the source of electrical power, the independence of the power sources for multiple EFBs, and the potential need for an independent battery source. Battery-powered EFBs having aircraft power available for recharging the EFB battery are considered to have a suitable backup power source. A procedure to ensure the safe recharge of the battery should be established. EFBs not having a battery power source are required to have the EFB connected to an aircraft power source.

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

a. an established procedure to recharge the battery from aircraft power during flight operations;

b. a battery or batteries with a combined useful battery life to ensure operational availability during taxi and flight operations, to include diversions and reasonable delays considering duration of flight; or

c. an acceptable mitigation strategy providing availability of aeronautical information for the entire duration of flight.

2.11.3 Battery Replacement. Battery replacement intervals should meet or exceed Original Equipment Manufacturer (OEM) recommendations. If the EFB manufacturer has not specified a battery replacement interval, then the original battery (or cell) manufacturer's specified replacement interval should be adhered to.

2.11.4 Lithium Batteries. Rechargeable lithium-type batteries are becoming more common as a source of principal power or standby/backup power in EFBs. Lithium-ion or lithium polymer (lithium-ion polymer) batteries are two types of rechargeable lithium batteries commonly used to power EFBs. The word "battery" used in this TAA-OAA Advisory refers to the battery pack, its cells, Battery Management System (BMS) and its circuitry. The guidance that follows in the sub-sections assumes the EFB will:

a. only use batteries recommended by the manufacturer;

b. be recharged only by devices expressly designed for recharge of the specific battery and will be continuously monitored while being charged;

c. contain no more than four cells in series (less than or equal to 18-Volt output) (reference 3.2.k); and

d. use batteries rated for no more than 100 Watt-hours (Wh), as listed in the manufacturer's specification, or calculated by multiplying the capacity in Ah by the maximum working (nominal performance) voltage.

Note

Contact DTAES 6-2 where planned usage of batteries between 101 to 160 Wh is anticipated (additional requirements will apply).

2.11.4.1 Safety Concerns

a. In general, batteries that are not physically or electrically abused, and operated within their environmental design limitations, provide a stable and safe power source. Quality control issues of commercially produced batteries also represent a failure risk. Mitigation of the safety concerns should be addressed by validating the presence of mitigating battery safety systems and procedures, as detailed in the Institute of Electrical and Electronic Engineers (IEEE) 1625-2008, IEEE Standard for Rechargeable Batteries for Multi-Cell Computing Devices (available internally, within DND, under RDIMS #1739431).

b. Abused batteries can be induced into thermal runaway by several means, including: over charging, shorting, rapid discharge, physical damage, crushing, puncturing and heating. Overheating may result in thermal runaway, which can cause the release of either molten lithium or a flammable electrolyte. Once one cell in a battery pack goes into thermal runaway, it produces enough heat to cause adjacent cells to also go into thermal runaway. The resulting fire can flare repeatedly as each cell ruptures and releases its contents.

c. For additional information on fighting fires caused by lithium-type batteries in portable electronic devices, refer to:

(1) IATA Lithium Batteries Risk Mitigation for Operators (available internally, within DND, under RDIMS #1739499); and

(2) FAA Safety Alerts for Operators (SAFO), Fighting Fires Caused by Lithium Type Batteries in Portable Electronic Devices (available internally, within DND, under RDIMS #1739492) and expanded information bulletin (available internally, within DND, under RDIMS #1739494).

2.11.4.2 Lithium Battery Safety and Testing Standards. Because of their proximity to the flight crew and potential hazard to the safe operation of the aircraft, the use of rechargeable lithium-type batteries in EFBs located in the aircraft flight deck must comply with certain international standards. Evidence that the batteries comply with the standards specified in subparagraph 2.11.4.2.a. and either: 2.11.4.2.b., 2.11.4.2.c., or 2.11.4.2.d. must be provided.

a. United Nations (UN) Transportation Regulations. UN ST/SG/AC.10/11/Rev.7, Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria (Para 38.3) (available internally, within DND, under RDIMS #2065517);

b. Underwriters Laboratory (UL). UL 1642, Standard for Lithium Batteries (available internally, within DND, under RDIMS #2067839); UL 2054 (available internally, within DND, under RDIMS #1543757), Standard for Household and Commercial Batteries; and UL 60950-1, Information Technology Equipment – Safety;

Note

Compliance with UL 2054 indicates compliance with UL 1642.

c. International Electrotechnical Commission (IEC). International Standard IEC 62133-2 (available internally, within DND, under RDIMS #2067841), Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells and for batteries made from them, for use in portable applications.

d. RTCA/DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems. An appropriate airworthiness testing standard, such as the latest version of 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, Additional Resources, should be used for guidance on applicable testing.

2.11.4.3 Showing Compliance. Proof of compliance to the requirements in 2.11.4.2, should be sought and retained, from credible sources (e.g., EFB manufacturer, battery OEM, etc.).

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

2.11.5 Use of Aircraft Electrical Power Sources

2.11.5.1 EFBs may connect directly to aircraft power through a certified power source. Appropriate labels should identify the electrical characteristics (e.g., 28 volts direct current (VDC), 1,500 milliamps (mA), 60 or 400 hertz (Hz)) of electrical outlets for EFB electrical connections.

2.11.5.2 The electrical load analysis (ELA) may need to be updated when new power sources are being added that are not currently included in the existing ELA.

2.11.5.3 A means (other than a circuit breaker) for the flight crew member to de-power the EFB power source or system charger should be provided.

2.12 Interference with Other Aircraft Systems

2.12.1 EFBs must demonstrate that they meet appropriate environmental qualification standards for radiated emissions for equipment operating in an airborne environment. Any EFB used in aircraft flight operations should be demonstrated to have no adverse impact on other aircraft systems (non-interference). The WSM Staff may accomplish the testing and validation to ensure proper operation and non-interference with other installed systems.

2.12.2 <u>EFB Electromagnetic Compatibility (EMC) Demonstration.</u> The WSM must demonstrate that all EFB components, including cords/cables for data or power, are electromagnetically compatible with aircraft navigation and communication systems in all phases of flight. This is accomplished via one of the methods described in paragraphs 2.12.3 or 2.12.4.

2.12.3 <u>PED-Tolerant Aircraft (Method 1).</u> Aircraft demonstrated as PED-tolerant for both transmitting and non-transmitting PEDs do not require specific aircraft EMC ground or flight tests. Aircraft PED tolerance may be demonstrated using guidance provided in TAA Advisory 2015-02 – *Demonstrating Aircraft E3 Tolerance to Electronic Devices* (reference 3.2.g).

2.12.4 <u>Aircraft EMC Tests (Method 2)</u>. This method should be used if the aircraft are not determined to be PED-tolerant in paragraph 2.12.3.

2.12.4.1 Radio Frequency (RF) Emissions. The WSM should obtain the RF emissions characteristics of the PED through RTCA/DO-160, *Environmental Conditions and Test Procedures for Airborne Equipment*, Section 21, Emission of Radio Frequency Energy; RF emissions tests; or an equivalent RF emissions test standard. If this data is not readily available, the PED can be sent to AETE for evaluation. DTAES 6-2 has a data base of previously qualified PEDs, and should be consulted prior to engaging AETE. Experience has shown successful qualification provides high assurance that the equipment will not interfere with aircraft radios or other aircraft electrical or electronic equipment or systems.

2.12.4.2 Charging Tests. If it is intended to allow charging of EFBs during flight, then the test setup should include testing under charging conditions. If it is intended to allow EFBs to charge in-flight and RF emissions test data is not available, then either a retest of the PED under the charging conditions or the performance of EMC ground tests according to paragraph 2.12.4.3 is recommended.

2.12.4.3 EMC Ground Tests. Perform aircraft EMC ground tests, if the PED's RF emissions test data reveals potential for interference, or if complete RF emissions data during all intended operating conditions is lacking. Configure the aircraft as prepared for taxi with doors and access panels closed, and ground-based electrical power disconnected. Power for the aircraft electrical and electronic systems should be from the aircraft generator(s) during testing. A PED EMC Test Plan is available in Annex B of the document referenced in 3.2.f.

Note

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

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

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

c. If the EFB includes a transmitter, such as a WiFi, cellular, or Bluetooth transmitter, it must be demonstrated that the EFB transmitter will not adversely affect other aircraft systems during the aircraft EMC ground tests. The EFB transmitters must be configured for such tests.

d. If the EFB will connect to the aircraft for power or battery charging, then the EMC ground tests should be performed with the EFB connected to the aircraft power source.

2.12.5 Aircraft EMC Flight Tests. If EMC ground tests conducted under paragraph 2.12.4 cannot adequately simulate the in-flight environment, or when the systems being evaluated for susceptibility cannot be operated on the ground, then additional EMC flight-testing should be conducted.

Note

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

2.13 Environmental Aspects other than E3

2.13.1 EFBs should perform their intended functions when used within their defined concept of operations (CONOPS). Given that the EFBs are typically off-the-shelf equipment, the OEM specification will describe the EFB environmental envelope. Since portable EFBs are not installed equipment and do not form part of the type certified aircraft, there is no requirement to perform a complete suite of RTCA DO-160 testing. The only exception is the requirement to conduct rapid decompression testing as detailed in 2.13.3.

2.13.2 The OEM environmental specification are accepted without further testing. However, the fleet will need to ensure and satisfy the OAA that:

a. the OEM environmental specifications will satisfy the intended CONOPS; and

b. where appropriate, the Operational Risk Analysis, required in Annex F, considers the impact of utilizing EFBs outside of the OEM specification due to probable aircraft system failure conditions (e.g., loss of all cabin heating) and addresses associated restrictions, limitation or mitigating strategies.

2.13.3 Worldwide aviation authorities have agreed that for pressurized aircraft the effects of a rapid decompression need to be assessed. Therefore:

a. Testing for rapid decompression must be accomplished to confirm that:

i. given the close proximity of the EFB to the flight crew, it does not pose safety hazards to the flight crew during a rapid decompression; and

ii. for EFBs that host applications that are required by the CONOPS to be used during flight following a rapid decompression in pressurized aircraft, those functionalities remain available for operational use.

b. Rapid decompression testing should be conducted in accordance with Mil-Spec 810F, Defence Standard 00-35, or RTCA/DO-160, Section 4, up to the maximum operating altitude of the aircraft in which the EFB is to be used. It is the responsibility of the Fleet and/or Fleet WSM seeking approval to obtain and retain documentation that these tests have been successfully accomplished (a finding of compliance is not required).

3. Software Application Evaluation

3.1. Responsiveness of Application

3.1.1 The system should provide feedback to the user, when user input is accepted.

3.1.2 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.

3.2 Readability

3.2.1 Text size and font for each application should ensure readability at the intended viewing distance, and page layout should ensure clarity and prevent any ambiguity.

3.2.2 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 application and intended operational function. If there is a cursor, it should be visible on the screen at all times while in use.

3.2.3 If the electronic document application supports multiple open documents, or the system allows multiple open applications, indication of which 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 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.

3.3 Colours

3.3.1 EFB are not certified to provide airworthiness warnings and cautions, however, they do provide important situational/contextual information. As such, the color RED should be used only to indicate a warning level condition, and the color AMBER should be used to indicate a caution level condition. Any other color may be used for items other than warning or caution conditions, providing that the colors used differ sufficiently from the colors prescribed to avoid possible confusion.

3.4 Messages

3.4.1 EFB messages and reminders should be clear and unambiguous. Messages should present minimum distraction to the flight crew. Messages should be prioritized and the message prioritization scheme evaluated and documented.

3.5 User Interface

3.5.1 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, color-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.

3.6 Data Entry

3.6.1 If user-entered data is not of the correct format or type needed by the application, the EFB should not accept the data. An error message should be provided that communicates which entry is suspect and specifies what type of data is expected. 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.

3.7 Possibility for Error/Confusion

3.7.1 The system should be designed to 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 in which latitude/longitude is entered should be the same across systems. Data entry methods, color-coding philosophies and symbology should be as consistent as possible across the various hosted EFB applications. These applications should also be compatible with other flight deck systems. Entered data should be displayed with the associated results of each calculation.

3.8 Workload

3.8.1 EFB software 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. 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.

ANNEX D
TO TAA-OAA ADVISORY 2012-01
DATED 1 MAY 2018
(REVISED IN MARCH 2021)

PORTABLE ELECTRONIC FLIGHT BAG EVALUATION CHECKLIST

Item	EFB Evaluation Checklist Items	Acceptable Yes / No / N/A
1	Stowage	
	Is stowage readily accessible in flight?	
	Shown that stowage does not cause obstruction during foreseeable aircraft operations? **[CERT]**	
	Shown that stowage does not cause any hazard during foreseeable aircraft operations? **[CERT]**	
2	Viewable Stowage (e.g., Suction cup mounts)	
	Is the make and model of the suction mount clearly specified?	
	Have the acceptable locations for securing the mounting device been adequately defined?	
	Have the effects of decompression on the effectiveness of the securing device been adequately considered?	
	Have instructions been provided for the securing and removal of the mounting device?	
	Has it been established that, if the mounted EFB becomes unsecured for whatever reason, it will not: • jam the flight controls (e.g. rudder pedals, tiller, yoke), • damage flight deck equipment, or • injure flight crew members?	
	Have maintenance requirements and instructions for long term care of the mounting device been provided to ensure the continued effectiveness of the securing device?	
	Have maintenance requirements and instructions for long term care of the window to which the suction cups are secured been considered or modified to account for the suction cup mounting?	
	Given that the security of the suction cup mount cannot be ensured during a decompression event, do the Standard Operating Procedures and/or Quick Reference Handbook adequately address this emergency condition?	
3	Cabling	
	If the EFB has associated cabling, is it long enough to perform the intended function?	
	Is it short enough that it will not hang loosely and compromise task or safety? **[CERT]**	
	Is there a means to secure the cable?	
4	Data Connection	
	Has the data connection been certified? **[CERT]**	
	Has it been determined that the EFB does not interfere with other aircraft systems? **[CERT]**	
	Is the aircraft systems and network security acceptable?**[CERT]**	
5	Mounting	
	Has the mounting device and its crashworthiness been certified? **[CERT]**	
	Has it been determined that the mounted EFB does not obstruct aircraft displays? **[CERT]**	
	Has it been determined that the mounted EFB does not obstruct aircraft controls? **[CERT]**	
	Has it been determined that the mounted EFB does not impede ingress or egress? **[CERT]**	
	Does the mounted EFB allow easy access to the EFB controls? **[CERT]**	
	Does the mounted EFB provide a clear view of the EFB displays? **[CERT]**	
	Is the mounting easily adjustable to accommodate flight crew member preferences? **[CERT]**	
	Can the mounting device be easily locked in place? **[CERT]**	
	Can the mounting device be stowed out of the way of crew member operations when not in use? **[CERT]**	
	If the mounting is on the control yoke, have flight control system dynamics been considered? **[CERT]**	
	Does the mounting present any hazard to any crewmember? **[CERT]**	
6	Position	
	Is it to be handheld and/or placed on the lap? (Note that if it is to be used during critical phases of flight, it must be secured to a kneeboard, viewable stowage device or aircraft mounting device).	
	Can the EFB be used without obstructing controls or instruments? **[CERT]**	
	Has it been demonstrated that the potential for confusion that could result from presentation of relative directions when the EFB is positioned in an orientation inconsistent with that information is acceptable?	
	Is the EFB within 90 degrees either side of the pilot's line of sight?	
7	Reflections	
	Will the EFB cause any unacceptable reflections or glare in the intended use position? **[CERT]**	
8	Lighting **[CERT]**	
	Is the display brightness adequately adjustable for day/night operations?	

Item	EFB Evaluation Checklist Items	Acceptable Yes / No / N/A
	Are controls and control labels adequately lit?	
9	Readability	
	Is display readable in all foreseeable lighting conditions including direct sunlight?	
10	Controls	
	Are all controls clearly labelled for their intended function?	
	Are the controls suitable for use in the cockpit?	
	Are the controls useable in turbulence?	
11	Electrical Power Sources	
	Is the EFB Power Source certified and appropriately labeled?	
	If an updated electrical load analysis is required, has it been completed satisfactorily? **[CERT]**	
	Is there a means, other than a circuit breaker, to disable the EFB in the event of unwanted operation? **[CERT]**	
	Did the design consider sources of electrical power and independence?	
	Was useful battery life established?	
	Was battery replacement interval identified?	
	If Lithium batteries are used, were use of Lithium battery safety concerns adequately addressed?	
12	Electromagnetic Interference with Other Aircraft Systems	
	Has EFB been shown to be EMC with the aircraft. **[CERT]**	
	Has the aircraft been shown to be PED tolerant? **[CERT]**	
	Have ground tests been conducted to demonstrate non-interference with other aircraft systems? **[CERT]**	
	Have flight tests been conducted to demonstrate non-interference with other aircraft systems? **[CERT]**	
13	Environmental Aspects other than E^3	
	If OEM environmental specifications do not satisfy the intended CONOPS or the OEM specifications could be exceeded due to probable aircraft system failures: have these been addressed in the Annex F Operational Risk Analysis?	
	Have rapid decompression tests been conducted and results provided?	
Comments:		
Limitations or procedures required for operational use:		

ANNEX E
TO TAA-OAA ADVISORY 2012-01
DATED 1 MAY 2018
(REVISED IN MARCH 2021)

ELECTRONIC FLIGHT BAG SOFTWARE APPLICATIONS EVALUATION CHECKLIST

Item	EFB Software Application Evaluation Items	Acceptable Yes / No / N/A
1	Responsiveness of Application	
	Is feedback provided for user input?	
	Is there an indication that the system is busy, if the system cannot process inputs immediately?	
	Is system response time predictable and consistent with the intended function?	
2	Readability	
	Does the text size and font ensure readability at the intended viewing distance?	
	Does the page layout provide sufficient clarity?	
	Is the cursor always visible?	
	Is indication of the active application/document provided?	
	Is it easy to switch between applications?	
3	Colour Usage	
	• Is RED only used to indicate a warning condition?	
	• Is AMBER only used to indicate a caution condition?	
4	Message Compatibility	
	Are EFB messages and reminders clear and unambiguous?	
	Do messages present minimum distraction to the flight crew?	
	Are messages prioritized?	
	Has the prioritization scheme been documented?	
5	User Interface	
	Is the user interface consistent and intuitive?	
	Is the user interface consistent with other EFB applications?	
	Are the applications consistent with other flight deck systems?	
6	Data Entry	
	Is the EFB prevented from accepting data of incorrect format or type?	
	Does the EFB provide error messages for incorrect data entries?	
	Are input errors detected at the earliest possible point in the input sequence?	
7	Possibility for Error/Confusion	
	Does the system minimize the occurrence of flight crew member error?	
	Does the system maximize the possibility of error detection?	
	Is entered data displayed with the results of each calculation?	
8	Workload	
	Has the effect of the EFB on pilot workload been evaluated in all applicable phases of flight?	
	Has the effect of the EFB on pilot workload been evaluated under applicable abnormal and emergency operations?	
Comments		
Limitations or procedures required for operational use		

OPERATIONAL EVALUATION AT THE FLEET LEVEL

1. Introduction

1.1 This Appendix provides details of the evaluation process at the Fleet level that is required prior to the operational phase-in of EFB hardware and/or software on CAF aircraft. The evaluation is focused on operational aspects that may be affected by the incorporation of EFB into flight operations. The results of this evaluation will be used to support the RCAF FOM requirements defined in reference 3.2.i.

1.2 Clarification on the responsibilities associated with the various operational entities is provided in reference 3.2.i.

1.3 The scope of the evaluation may be greater than that provided below, depending on the actual implementation. However, as a minimum, the items listed below should be considered. An associated checklist is contained in Annex G and can be customized as required.

2. EFB Administrator

2.1 An EFB Administrator (EFBA), responsible for ensuring ongoing compliance with the items in this Appendix and providing support in day-to-day EFB operations, should be designated.

2.2 The EFBA should be suitably qualified and trained to carry out this role. The EFBA should be provided with adequate resources to carry out the duties of the position, including the authority to act on behalf of the Fleet/Wing in matters within the EFBA designated purview.

3. Crew Procedures

3.1 Clear limitations and crew procedures should be provided and documented for all phases of flight. A system description and operating philosophy should be included.

3.2 Procedures should:

a. be properly integrated with existing Standard Operating Procedures (SOPs);

b. contain suitable crew crosschecks for verifying safety critical data;

c. mitigate and/or control any additional workload associated with the EFB;

d. provide contingency procedures for total or partial EFB failure;

e. cover system reboots, lock-ups and recovery from incorrect crew actions;

f. include a requirement to verify the revision status of software;

g. include a requirement to verify that software applications and information contained in the EFB intended for operational use are current and up-to-date; and

h. ensure the EFB transmit functionality is disabled during classified communications.

4. Operational Risk Analysis

4.1 An operational risk analysis should be conducted to determine appropriate procedures to eliminate, reduce, or control risks associated with identified failures in the EFB system. The analysis should ensure that the EFB system achieves at least the same level of accessibility, usability and reliability (e.g., may drive requirement for more than one EFB) as the system it replaces (e.g., paper charts).

4.2 The operational risk analysis should consider:

a. total and partial failures of the EFB;

b. where applicable, the impact of utilizing an EFB outside of the OEM environmental specifications, due to probable aircraft system failure conditions;

c. loss of data;

d. corrupt/erroneous outputs;

e. failure of batteries, causing fire; and

Note

There is currently no published DND/CAF operational guidance on addressing Lithium battery fires. Therefore, Fleets are advised to consider current civil aviation direction on Lithium battery fires where/when applicable and practical. This direction is contained in the FAA SAFO document at reference 3.2.j.

f. MEL dispatch condition.

5. Training Program

5.1 A suitable training program for ground staff and crew members should be established. Once it is established, the training program should be evaluated to determine that:

a. the program is fully documented;

b. the training methodology matches the level of knowledge and experience of the participants;

c. adequate resources have been assigned to deliver the training;

d. adequate EFB and/or EFB simulation equipment has been provided;

e. Human Factors and cockpit resource management are included in the training;

f. the training material matches both the EFB equipment status and the published procedures;

g. the training program incorporates training for system changes and upgrades; and

h. if applicable, the training program maintains crew proficiency in non-EFB (e.g., paper charts) procedures.

6. Hardware Management Procedures

6.1 Documented procedures for the control of hardware and component stocks covering removal, repair, replacement, re-installation and maintenance should be established.

7. Software and Management Procedures

7.1 Documented procedures for the control of installed software should be established. These procedures should include:

a. a clear definition of who has access rights to install or modify software;

b. adequate controls to prevent user corruption of operating systems and software; and

c. adequate security measures to prevent malware and unauthorized user access.

8. Data Management Procedures

8.1 Documented data management procedures should be established. These procedures should:

a. interface satisfactorily with procedures used by external data providers;

b. define access rights for users and administrators; and

c. provide adequate controls to prevent user corruption of data.

9. Security Procedures

9.1 In general, civilian aircraft operators are currently required to demonstrate that adequate security measures are in place to obtain suitability of operations approval on a case-by-case basis. The safety effect on aircraft operations will vary based on the hosted software applications and intended EFB functionality. Guidance on aircraft cybersecurity is provided in the ADSM (reference 3.2.h).

9.2 The required level of EFB security depends on the criticality of the hosted functionality. For instance, an EFB that only holds a list of fuel prices may require less security than an EFB used for performance calculations.

9.3 A plan should be developed to demonstrate that adequate security measures are in place to prevent unauthorized modifications to the EFB operating system, its specific hosted applications, and any of the databases or data links required to enable its hosted applications. This includes an assessment of potential threats and hazards to the EFB, and the development of methods to address these. This plan should be reviewed and updated on a regular basis.

9.4 An approved configuration for EFBs should be maintained. This configuration should be reviewed and updated regularly, and upon discovery of any vulnerabilities or flaws affecting the EFB hardware, operating system or applications. This configuration should, at a minimum, include:

a. a list of approved applications, with version numbers;

b. a list of approved settings for any approved applications, where applicable;

c. a list of hardware settings, i.e., physical switch and button positions; and

d. a list of operating system settings.

9.5 Adequate procedural security measures should be implemented in instances where technical measures are not appropriate or suitable. A non-exhaustive list includes:

a. physical security, e.g., use of locked storage containers;

b. asset tracking, e.g., sign-in/sign-out of EFB by authorized users; and

c. other security aspects to be controlled procedurally rather than technically, e.g., use of USB ports, use of physical media.

9.6 The EFB system shall have no adverse impact upon any aircraft system, including but not limited to flight control systems, navigation, maintenance-related systems, and mission systems not required for safe flight.

9.7 Appropriate procedures shall be established to permit the EFBA to determine whether an unsafe condition exists following attempted access to systems and networks by unauthorized sources.

10. Use of Own-ship Position

10.1 EFB Own-ship Functionality

a. Mounting evidence suggests that, when an enroute diversion occurs, the use of EFBs for situational awareness contributes to reducing pilot workload, thereby increasing safety.

b. Own-ship functionality should only be used for strategic purposes (e.g., situational awareness) contributing to flight crew decision-making and is not to be used as a tool for surface manoeuvring or airborne manoeuvring/navigation.

c. EFB applications may display an EFB own-ship symbol for both in-flight and surface use. The risk of providing misleading position to flight crew during operations should be minimized.

10.2 EFB Own-Ship Position Requirements

a. *Positional Awareness*. EFB own-ship position is limited to serve as an aid to positional awareness.

b. *Position Source Selection*. It is recommended to use position data from an installed Global Navigation Satellite System (GNSS) source. Position data from a portable GNSS source is acceptable, provided it supports the application requirements and it works as intended in the aircraft environment.

c. *Own-ship Directionality*. Change own-ship symbol to a non-directional (e.g., circular) depiction when track or heading is not available or cannot be calculated based on GNSS data.

d. *Own-ship GNSS Data Stream*. Remove own-ship symbol if the GNSS data stream stops. This will guard against a "frozen" own-ship condition caused by position source signal or power loss and removal should occur in a timely manner.

e. *Own-ship Surface Use Accuracy*. For airport map applications, the applicant should choose a database with an accuracy of five meters or less. For airports where such data is not currently available, a database accuracy of 30 meters can still be operationally useful. If the database accuracy exceeds 30 meters, EFB own-ship position should not be displayed.

Note

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

f. *Map Zoom*. The application will need to indicate the current level of zoom on the display. The design should ensure the zoom level is compatible with the position accuracy of the own-ship symbol.

10.3 Training Requirements for Use of Own-Ship Position

10.3.1 Training to use EFB own-ship position on EFB applications should emphasize the limitations of this supplemental tool for use by the flight crew. Training should include the following:

a. EFB own-ship position is for positional awareness only. Crews may not use EFB own-ship position to maneuver the aircraft.

b. The flight crew’s reference for maneuvering the aircraft on the ground is visual identification of the airport, taxiway, and runway signage and markings.

c. The flight crew’s reference for maneuvering the aircraft in the air is the installed primary flight and navigational displays. When a conflict occurs between the primary flight navigation displays and the EFB, the flight crews must utilize the primary displays.

d. Reporting positioning or database errors when visual checks reveal display discrepancies.

10.4 Fleet EFB Standard Operating Procedure shall include the following statement:

“This EFB is not certified as a navigation system. The TAA has not assessed the EFB for performance or reliability of the platform hardware or software (including GPS functionality).”

OPERATIONAL EVALUATION CHECKLIST – FLEET LEVEL

Item	Operational Evaluation Checklist – Fleet level	Acceptable Yes / No / N/A
1	EFB Administrator (EFBA)	
	Is the nominated EFBA suitably qualified and trained?	
	Do the listed responsibilities match the requirements of the system?	
	Are there adequate resources assigned to the EFBA function?	
2	Crew Procedures	
	Are there appropriate procedures for all phases of flight?	
	Are the procedures clearly presented, suitably illustrated and readily understood?	
	Is there a clear description of the system, its operating philosophy and operational limitations?	
	Has the information in the Aircraft Flight Manual Supplement (AFMS) been incorporated into the company Standard Operating Procedures (SOPs)?	
	Have crew procedures for EFB operation been integrated with existing SOPs?	
	Are there suitable crew cross-checks for verifying safety-critical data?	
	Is any additional workload mitigated/controlled?	
	Are there contingency procedures for total or partial EFB failure?	
	Do the procedures cover system re-boots, lock-ups and recovery from incorrect crew actions?	
	Do crew procedures include a requirement to verify the revision status of software and data?	
	Are crew procedures to ensure the EFB transmit functionality is disabled during classified communications acceptable?	
3	Operational Risk Analysis	
	Has total and partial failures of the EFB been considered?	
	Has loss of data and corrupt/erroneous outputs been considered?	
	Has the impact of the EFB on the MEL been assessed?	
	Have strategies and procedures been implemented to deal with a battery fire?	
4	Training Program	
	Are flight crew members and (where applicable) ground staff training programs fully documented?	
	Is the training methodology matched to the participants' level of experience and knowledge?	
	Have adequate resources (time/personnel/facilities) been assigned for training?	
	Is there access to actual or simulated EFB equipment for interactive training?	
	Does the training material match the EFB equipment status and published procedures?	
	Does the training program include human factors/Crew Resource Management in relation to EFB use?	
	Does the training program incorporate training for system changes and upgrades?	
	In cases where multiple variants of the same aircraft are being operated, has the impact on training/checking and currency been assessed?	
	Is there a published recurrent training, checking and currency program?	
	If applicable, does the training program maintain crew proficiency in non-EFB procedures (e.g., paper charts)	
5	Hardware Management Procedures	
	Are there controlled documented procedures for the control of hardware and component stocks?	
	Do the procedures include repair, replacement and maintenance of EFB equipment and peripherals?	
6	Software Management Procedures	
	Are there documented procedures for the control of installed software?	
	Are the access rights for personnel to install or modify software components clearly defined?	
	Are there adequate controls to prevent user corruption of operating systems and software?	
	Are there adequate security measures to prevent system degradation, viruses and unauthorized access?	
	Are procedures defined to track database expiries and obtain and install monthly chart database updates?	

Item	Operational Evaluation Checklist – Fleet level	Acceptable Yes / No / N/A
7	Data Management Procedures	
	Are there documented procedures for the control and management of data?	
	How do the procedures interface with procedures used by external data providers?	
	Are the access rights for users and administrators to manage data clearly defined?	
	Are there adequate controls to prevent user corruption of data?	
8	Security Procedures	
	Is there an acceptable plan to prevent unauthorized modifications to EFB system and is there a mechanism to identify, assess and protect against security threats?	
	Are there acceptable configuration control mechanisms in place?	
	Has it been verified that EFB does not accept a data load that contains corrupted contents?	
	Are there adequate procedural security measures implemented where technical measures are not appropriate or suitable?	
9	Use of Own-Ship Position	
	Does implementation minimize the possibility of displaying misleading own-ship position to flight crews?	
	Does own-ship symbol change to a non-directional depiction when heading or track not available?	
	Is own-ship symbol removed when GNSS data stream no longer available?	
	If applicable, has confirmation of five-meter airport map database accuracy been obtained?	
	Is current level of zoom indicated on display?	
	Have own-ship training requirements been incorporated into EFB training program?	
	Has the following been added to the Fleet SOP: *“This EFB is not certified as a navigation system. The TAA has not assessed the EFB for performance or reliability of the platform hardware or software (including GPS functionality).”*	

Comments

Limitations or procedures required for operational use

OPERATIONAL AIRCRAFT EVALUATION

1. Introduction

1.1 This Appendix provides details of an operational evaluation to ensure that operations can be safely conducted using the proposed EFB procedures. This evaluation may be combined with the installation evaluation described in Appendix C, or conducted separately, as circumstances warrant.

1.2 The scope of this operational evaluation may be greater than that provided below, dependent on the actual implementation. However, at a minimum, the items listed below should be considered. An associated checklist is contained in Appendix I and can be customized as required.

2. General Operation

2.1 The guiding principle of operations with an EFB is that flights should be able to be conducted as safely with an EFB as with the methods or products that the EFB is intended to replace. The EFB should not add an unacceptable level of complexity for any critical activity or phase of flight. For systems with multiple EFBs, in the event of an output discrepancy, there should be a means for the crew to decide which output is correct.

3. Workload

3.1 The implementation of EFBs should not cause a significant increase in crew workload due to positioning, using and stowing, particularly during critical flight phases. Procedures should be put in place to minimize workload and prevent crew distraction. Factors which could increase pilot workload, such as loss of an EFB, should be considered.

4. Installation Aspects Specific to the Operation

4.1 All aspects of the proposed EFB procedures should be evaluated in the aircraft or a simulator representative of the aircraft to ensure that any installation issues specific to the proposed operation are identified and mitigated.

5. Aircraft Performance Calculations

5.1 The Fleet/Fleet WSM should have a means to verify that the EFB outputs for aircraft performance calculations match the AFM. The EFB should have been determined during the installation evaluation to minimize the possibility of confusion and data entry errors. It should be confirmed that flight crew members using the provided procedures find data entry to be easy and unambiguous. It should also be determined that the procedures allow for adequate crosscheck between crew members.

6. Electronic Navigation Charts

6.1 It should be determined that crews are able to use the electronic navigation charts as readily as paper charts. The ability to easily select charts should be evaluated and the ability of the system to accommodate short notice changes, such as a change of runway, should be assessed. The possibility of crew confusion resulting from chart orientation, automatic chart selection or de-cluttering should be evaluated and mitigation should be proposed for any issues arising.

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

6.3 Instrument Approach Procedures (IAP). The screen should display an IAP chart in an acceptable aeronautical chart format similar to a published paper chart. The screen should be large enough to show the entire standard format, one-page IAP chart all at once, with a degree of legibility and clarity equivalent to the paper chart being replaced. This requirement is not meant to preclude panning and zooming features, but is intended to prevent a workload increase during the approach phase of flight.

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

7. Electronic Checklists

7.1 Electronic checklist features should be evaluated to determine whether crews are able to use them as well as paper checklists. The status of checklist items should be clear to the crew and it should be easy for the crew to change the status of each item. The potential to skip checklist items or assign incorrect actions should be minimized. The complete or incomplete status of the checklist should be clear to the crew.

AIRCRAFT OPERATIONAL EVALUATION CHECKLIST

Item	Operational Evaluation Checklist – Aircraft	Acceptable Yes / No / N/A
1	General	
	Can flights be conducted as safely with an EFB as with the methods/products it is intended to replace?	
	Has it been determined that there are no noticeable conflicts between EFB and flight system interfaces, or between multiple EFBs?	
	Has it been determined that, in the event of an output discrepancy, there is a means for the crew to know which output is primary?	
	Has it been determined that the EFB does not add an unacceptable level of complexity for any critical activity or phase of flight?	
2	Workload	
	Is the workload with an EFB less than, or equal to, the workload for equivalent tasks without an EFB?	
	Has it been determined that the EFB does not distract pilots during critical phases of flight?	
	Are there policies/procedures in place to mitigate workload/distraction problems?	
3	Aircraft Performance Calculations	
	Can the Fleet and/or Fleet WSM verify that aircraft performance data outputs match AFM performance data? How?	
	Is the entry and manipulation of data easy and unambiguous?	
	Does the system provide suitable error messages for inappropriate input/output?	
	Does the system allow adequate cross-checks between crew members in practice?	
4	Electronic Navigation Charts	
	Can crews use electronic charts as well as they use paper charts?	
	Can the system easily accommodate short notice changes (e.g., re-clearance, change of runway)?	
	Do zoom and pan features ensure that critical items are not lost from view? Do scale and orientation indications remain visible? Does the scale indication remain accurate?	
	Do display or orientation options ensure that crews do not become confused about display orientation?	
	Can the selection be manually overridden?	
	Is displayed position accurate within the displayed scale?	
	Externally-sensed inputs (e.g., overlay of current aircraft position): Does the system automatically select relevant charts?	
	Does the system ensure that: ▪ critical items are not lost from view in de-cluttered mode? ▪ there is a clear indication that the de-cluttering feature is active? ▪ electronic charts are as accurate and usable as conventional paper charts?	
5	Electronic Checklists	
	Can crews use electronic checklists as well as they use paper checklists? How does crew coordination of checklist actions work in practice?	
	Is progress through the checklist and the status of items (complete/deferred/open) clear to the crew?	
	Can the crew easily change the status of an action item?	
	Can the crew remove completed actions in order to restart the checklist from the beginning?	
	Is the potential to skip checklist items or assign incorrect actions minimized?	
	Can the crew easily navigate through the checklist? Are deferred actions appropriately displayed?	
	Is it clear when a checklist is incomplete?	
	Are decision branches clearly displayed? Can the selection of an incorrect branch be reversed?	
	Are reminders displayed for delayed actions (e.g., fuel dumping)?	
Comment		
Limitations or procedures required for operational use		

GUIDANCE FOR THE DEVELOPMENT OF EFB SOFTWARE APPLICATIONS

Preamble

This annex provides information to the Fleets on best practices and general guidance for the development of the following EFB Type B Software Applications:

1. Takeoff/Landing Performance and Mass & Balance Applications;
2. Electronic Charting Applications;
3. Taxi Aid Camera Systems;
4. Airport Moving Map Display;
5. Electronic Checklists Applications; and
6. Inflight Weather Applications;

The requirements and methods that are discussed are not intended to preclude alternate methods that may accomplish similar objectives. The base material for this annex originated in the ICAO EFB Manual Doc. 10020, revision 2 (reference 3.2.d). It has been customized to reflect DND/CAF nomenclature.

Note

Since the publication of the ICAO EFB Manual Doc. 10020 revision 2, EASA has been considering the use of an EASA European Technical Standard Order (ETSO) authorization for EFB software applications. The development of an industry standard for EFB Software Applications was a precursor to EASA's initiative. Therefore, the European Organization for Civil Aviation Equipment (EUROCAE) Working Group (WG)-106 "Electronic Flight Bag Software Applications" was created. The purpose of WG-106 was to identify the minimum requirements that any EFB application must meet, and develop corresponding test criteria and parameters. To this end, the working group has prepared a draft EUROCAE Document (ED) 273 titled: "Minimum Operational Performance Standards for EFB Software Applications". As of the publication date of this TAA-OAA Advisory, ED-273 has not yet been approved and released. Once ED-273 is officially released, the TAA and the OAA will revisit the contents of this Annex against ED-273, with a goal of either updating the contents or potentially replacing the entire annex with a reference to EUROCAE ED-273, as appropriate.

Since the software applications described in this annex reside on a portable EFB and are not part of the aircraft Type Design, the responsibility for the assessment of these software applications resides with the OAA. The DTAES staff would be able to provide assistance with these assessments through an Engineering Support (ES) tasking, if requested to do so. The OAA should direct requests for ES taskings to DTAES 6.

1. TAKEOFF/LANDING PERFORMANCE (TALP) AND MASS AND BALANCE (M&B) APPLICATIONS

1.1 Introduction

1.1.1 The validity and integrity of TALP and M&B data are essential for safe flight operations. These types of EFB applications, and the operator's procedures for their use, require thorough evaluation prior to being approved for service.

1.1.2 The application architecture, human-machine interface (HMI), documented testing results, and the operator's EFB procedures and training should be assessed before approving the operational use of EFB TALP and M&B applications.

1.2 TALP Application Architecture

1.2.1 TALP applications are usually separated into different layers:

a. HMI;
b. calculation module;
c. aircraft-specific information; and
d. airport, runway, obstacle database (AODB).

1.2.2 Figure A-1 shows a typical architecture of a TALP application. Individual solutions that are in use by operators might not need to be as modular as shown, but, rather, have the different parts integrated into one software. Alternatively, there might be solutions where modularity is taken to a point where some or all parts are supplied by different providers.

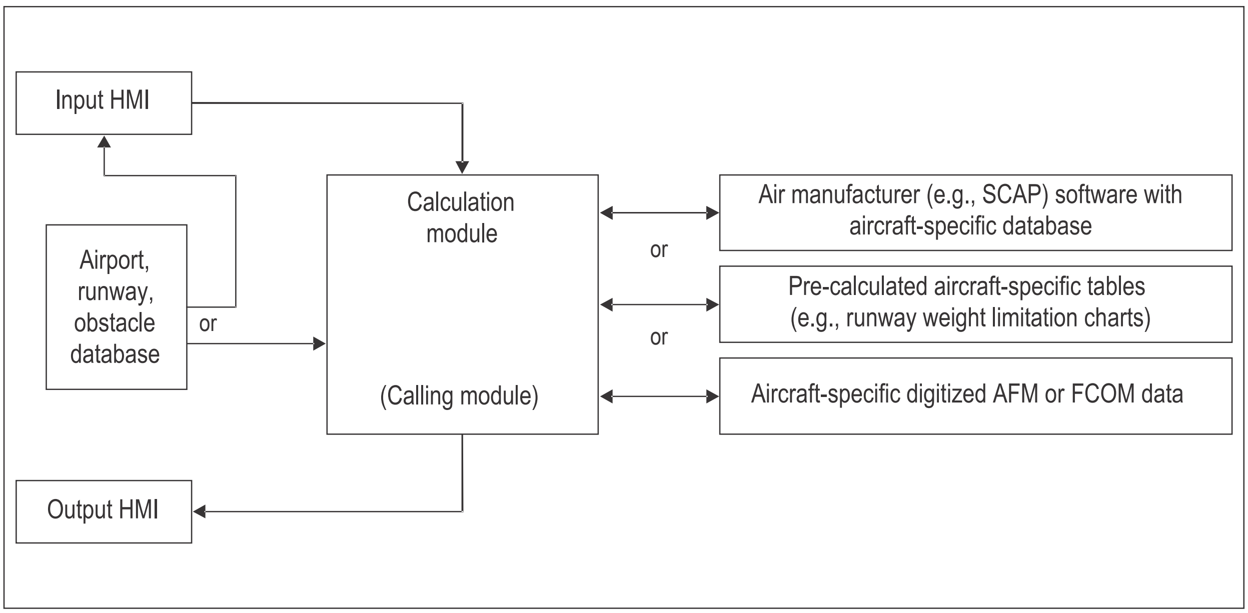

Figure A-1. Typical architecture of a TALP application

1.2.3 *Input and output HMI.* The input HMI takes the pilot's inputs (or data read from the avionics, if applicable) and requests the calculation from the calculation module. The results are transferred to the output HMI.

1.2.4 *Calculation module.* The calculation module will process the data from the input HMI and determine the results, which are then sent back to the output HMI.

1.2.4.1 TALP source data is generally derived from either pre-calculated tables (e.g., runway weight limitation charts), digitized AFM or FCOM charts, or equations of motion-based software algorithms and data.

1.2.4.2 For TALP source data that is either digitized AFM data or based on equations of motion, the data is generally provided in a form that complies with the International Air Transport Association (IATA) Standard Computerized Airplane Performance (SCAP) specification. The IATA SCAP specification provides a standardized means for manufacturers, operators, and third parties to exchange airplane performance data.

1.2.4.3 A typical software system that uses the SCAP approach will consist of the calling module, a “SCAP module” (also known as a “manufacturer’s module”) and SCAP data. To obtain results, the calculation module assembles the inputs from the HMI and other sources and might call the SCAP module several times. Thus, the expression “calling module” has become widespread in the industry.

1.2.4.4 Another way for the calculation module to obtain results is to interpolate between pre-calculated tables (e.g., runway weight limitation charts).

1.2.4.5 In some cases, where manufacturer software and data is not available, or when other commercial purposes exist, paper AFM or FCOM charts may be digitized by third parties that develop the data for their own commercial products.

1.2.5 *Aircraft Performance data sources*. Different sources of performance data can be used by TALP applications. Performance data can be delivered in various digitized formats:

a. SCAP modules or the equivalent delivered by the manufacturer.
b. the operator can build its own digitized aircraft performance data, based on the data published in the flight manual; and
c. data based on pre-calculated takeoff or landing performance tables.

1.2.6 *Airport, runway, obstacle database (AODB)*. Takeoff and landing performance applications require information about airport, runway and obstacles. The AODB should provide this information in a suitable way. Usually, it is the part of the EFB performance applications that will be updated most often. The management of this data is critical. The operator is responsible for the data quality, accuracy and integrity of the runway and obstacle data, and should ensure this together with the data provider.

1.3 Takeoff and Landing Performance and Mass and Balance Applications HMI

1.3.1 Pilot data entry errors have been a contributing factor to numerous aviation incidents and accidents. A well-designed HMI can significantly reduce the risk of errors. The following design guidelines should be followed:

a. input data and output data (results) should be clearly distinctive. All the information necessary for a given task should be presented together or easily accessible;
b. all data required for TALP and M&B applications should be prompted for, or displayed, including correct and unambiguous terms (names), units of measurement (e.g., kg or lbs). The units should match those from other cockpit sources for the same type of data;
c. field names and abbreviations used in the HMI should correspond to those present in the flight manuals and labels in the cockpit;
d. if the application computes both dispatch (regulatory, factored) and other results (e.g., in flight or not factored), the flight crew should be made aware of the nature of the results;
e. the application should clearly distinguish user entries from default values or entries imported from other aircraft systems;
f. the aircraft tail sign used for calculation should be clearly displayed to the flight crews, if relevant differences between tail signs exist. If tail signs are associated with different sub-fleets, the selected sub-fleet should be clearly displayed to the flight crew;
g. the HMI should be designed so that input data is difficult to enter into the wrong fields of the HMI, by defining data entry rules;
h. the HMI should only accept input parameters within the aircraft’s operational envelope approved for the operator (commonly more limiting than the certified envelope). Consideration should be given to the plausibility of outputs within the AFM envelope, but outside normal operating

conditions;

i. all critical TALP calculation assumptions (e.g., use of thrust reversers, full or reduced thrust/power rating) should be clearly displayed. The assumptions made about any calculation should be at least as clear to pilots as similar information would be on a tabular chart;

j. the HMI should indicate to the pilot if a set of entries results in an unachievable operation (for instance, a negative stopping margin);

k. the user should be able to modify its input data easily, especially to account for last-minute changes;

l. when calculation results are displayed, they should be displayed together with the input parameters used for the calculation.

m. any active MEL/CDL/special restriction should be clearly visible and identifiable;

n. in case of multiple runway selection, the output data should be clearly associated with the selected runway; and

o. changes of runway data by the pilot should be clearly displayed and the changes should be easy to identify.

1.4 TALP and Mass and Balance Applications Testing

1.4.1 Accurate TALP and M&B calculations are essential to safe aircraft operation. EFB applications can be effective tools used to make these calculations. EFB applications that use mathematical algorithms or calculation modules should be thoroughly tested before being approved for operational use.

1.4.2 Applications designed to perform TALP and M&B calculations must use data derived from the AFM or other appropriate sources, as deemed acceptable by the TAA.

1.4.3 Application testing should be conducted with the application running on a representative operating system and hardware device.

1.4.4 A proper evaluation of a TALP or M&B EFB application includes documented testing that verifies the calculation accuracy, user interface, and complete environmental integration. The extent of testing and supporting documentation should reflect the complexity and functionality of the application being tested.

1.4.5 *Calculation Accuracy Tests.* Tests designed to verify an application calculates TALP and M&B results that are consistent with the AFM data or advisory data provided by the aircraft manufacturer.

1.4.5.1 The results of TALP applications are influenced by a large number of input parameters, and, therefore, it is not feasible to verify all possible outputs for accuracy. Test cases should be defined to sufficiently cover the entire operating envelope of the aircraft under a representative cross section of conditions for TALP applications (e.g., runway surface condition, runway slope, wind, temperature, pressure altitude, obstacle clearance, and aircraft configuration including failures with a performance impact, etc.).

1.4.5.2 The results of M&B applications are also influenced by a large number of input parameters, and, therefore, it is not feasible to verify all possible outputs for accuracy. Test cases should be defined to sufficiently cover the entire operating envelope of the aircraft under a representative cross section of conditions for M&B applications (e.g., fuel load schedules, including varying fuel densities or actual fuel density, if known, passenger load schedules, cargo load schedules, and unique or special cargo loads).

1.4.5.3 Test cases should also be defined to sufficiently cover a representative cross section of an operator's aircraft (e.g., different aircraft types, models, configurations, and modifications, etc.).

1.4.5.4 Test cases should contain a detailed check showing that the application produces results that match, or are consistently conservative to, results derived from previously approved methods accepted by the OAA.

1.4.5.5 An applicant should provide an explanation of the methods used to evaluate a sufficient number of testing points with respect to the design of their software application and databases.

1.4.5.6 Test cases should demonstrate the application is stable and produces consistent results each time the process is entered with identical parameters.

1.4.5.7 Tests should be acceptable to the OAA.

1.4.6 *User Interface Tests*. Tests designed to verify that an application's user interface is acceptable.

1.4.6.1 Test cases should be defined to demonstrate compliance with the HMI requirements in Section 1.3.1.

1.4.6.2 Test cases should be defined to demonstrate the application has a reasonable system response when incorrect values are inadvertently entered.

1.4.6.3 Test cases should be defined to demonstrate that the application provides easily comprehended results or error messages/instructions, if incorrect input values (outside envelope, wrong combination of inputs, etc.) are entered.

1.4.6.4 Test cases should be defined to demonstrate that the application does not fail or get into a state that would require special skills or procedures to bring it back to an operational state, if incorrect input values are entered.

1.4.7 *Operational Integration Tests.* Tests that demonstrate that the application runs properly in the complete operational environment for which the EFB application is to be used.

1.4.7.1 Test cases should be defined to demonstrate the application functions correctly on the EFB platform.

1.4.7.2 Test cases should be defined to demonstrate the application does not adversely impact other EFB applications or aircraft systems, or vice versa.

1.4.7.3 Test cases should be defined to demonstrate the application correctly interfaces with other applications, when applicable (e.g., Take-Off (T/O) performance using results from Weight and Balance (W&B) application).

1.5 Procedures, Management and Training. The evaluation of EFB applications that calculate TALP and M&B data should take into consideration all other processes, procedures and training that support the use of the application.

1.5.1 *Normal Operating Procedures*

1.5.1.1 Procedures should ensure the proper use of EFB applications that calculate TALP or M&B data. The procedures should apply to the flight crew and ground personnel (Flight Dispatchers, Flight Operating Officers, Operating personnel, etc.) who may have roles defined in the use of the applications.

1.5.1.2 TALP and M&B data should be independently calculated and crosschecked by both pilots. When a dispatch system described in ICAO Annex 6 Part 1, Chapter 3 is used for the control and supervision of flights, the flight dispatcher (or other ground staff assigned) should verify the results are within operating limits. Any differences should be discussed before the results are used operationally. All M&B documents should be available to the dispatcher or the person on the ground responsible for the control and supervision of flight before take-off.

1.5.2 *Abnormal Operating Procedures*

1.5.2.1 Procedures should ensure a high level of safety can be maintained consistent with the EFB risk assessment assumptions during a loss of EFB functionality (e.g., the loss of a single application or the failure of the device hosting the application).

1.5.3 *Security Procedures*

1.5.3.1 The application and the data it references should be checked for integrity and protected against unauthorized manipulation (e.g., by checking file checksum values at EFB start-up, or prior to each calculation.)

1.5.4 *Training*

1.5.4.1 Training should emphasize the importance of executing all TALP and M&B calculations in accordance with SOP to assure fully independent and cross-check calculations. As an example, one pilot should not announce the values to be entered into the HMI of the performance applications, because a wrong announcement could lead to both calculations showing the same misleading results.

1.5.4.2 Training should include cross-checks (e.g., with avionics or flight plan data) and gross error check methods (e.g., “rule-of-thumb”) that may be used by pilots to identify order-of-magnitude errors like entering the Zero Fuel Mass as Takeoff Mass or transposed digits.

1.5.4.3 Training should emphasize that the use of EFBs makes TALP and M&B calculations simple and does not eliminate the necessity of good pilot performance knowledge.

1.5.4.4 Through the use of EFBs, new procedures may be introduced (e.g., the use of multiple flaps settings for takeoff) and pilots should be trained accordingly.

1.5.5 *Management of Takeoff and Landing Performance and M&B EFB Applications*

1.5.5.1 The responsibilities between the TALP and M&B management and the EFB management should be clear and well-documented. A designated person/group who is sufficiently trained should provide support for the performance tools. This person/group should have comprehensive knowledge of current regulations, TALP and M&B, and TALP and M&B software (e.g., SCAP modules) used on the EFB.

2. ELECTRONIC CHARTING APPLICATION

2.1 Description

2.1.1 An EFB software application that supports route planning, route monitoring and navigation by displaying required information and includes visual, instrument and aerodrome charts.

2.2 Considerations for Electronic Charting Applications

a. electronic aeronautical charts should provide, at least to a minimum, a level of information and usability comparable to paper charts;
b. for approach charts, the EFB software application should be able to show the entire instrument approach procedure all at once on the intended EFB hardware, with a degree of legibility and clarity equivalent to that of a paper chart;
c. an EFB display may not be capable of presenting an entire chart (e.g., airport diagram, departure/arrival procedures, etc.) if the chart is the expanded detail (fold-over) type;
d. panning, scrolling, zooming, rotating, or other active manipulation is permissible; and
e. for data driven charts, it should be assured that shown symbols and labels remain clearly readable (e.g., not overlapping each other). Layers of data may be used for de-cluttering.

Note

See also Annex 4 – Aeronautical Charts*, Chapter 20* – Electronic Aeronautical Chart Display, ICAO.

3. TAXI AID CAMERA SYSTEM (TACS)

3.1 Description

3.1.1 TACS is an EFB software application used to increase situational awareness during taxi by displaying electronic real-time images of the actual external scene.

3.2 Considerations for TACS:

a. ensure real-time, live display of received imagery without noticeable time-lapse;
b. adequate image quality during foreseeable environmental lighting conditions;
c. display of turning or aircraft dimension aids may be provided (e.g., turning radius, undercarriage track width, etc.). In such cases, the information provided to the pilot should be verified to be accurate;
d. connection to one or more installed vision systems. Vision systems include, but are not limited to, visible light cameras, forward-looking infrared sensors and intensifying low-light level images;
e. operators should establish SOPs for use of TACS. Training should emphasize use of TACS as an additional resource and not as a primary means for ground navigation or avoiding obstacles; and
f. pilot use of TACS should not induce disorientation.

4. AIRPORT MOVING MAP DISPLAY (AMMD)

4.1 Description

4.1.1 This section provides some considerations on how to demonstrate the safe operational use for AMMD applications to be hosted on EFBs.

4.1.2 An EFB AMMD with own-ship position symbol is designed to assist flight crews in orienting themselves on the airport surface to improve pilot positional awareness during taxi operations. The

AMMD function is not to be used as the primary means of taxiing navigation. This application is limited to ground operations only.

4.1.3 The AMMD application is designed to indicate aeroplane position and heading (in case the own-ship position symbol is directional) on dynamic maps. The maps graphically portray runways, taxiways and other airport features to support taxi and taxi-related operations. Additionally, warning functions can be provided which notify crews about potentially dangerous conditions, e.g., inadvertently entering a RWY.

4.2 Considerations for AMMD:

a. an AMMD application should not be used as the primary means of taxiing navigation; primary means of taxiing navigation remains the use of normal procedures and direct visual observation out of the cockpit window;
b. the total system error of the end-to-end system should be specified and characterized by either the AMMD software developer, EFB vendor or OEM, etc. The accuracy should be sufficient to ensure that the own-ship position symbol is depicted on the correct runway or taxiway;
c. the AMMD should provide compensation means for the installation-dependent antenna position bias-error, i.e., along-track error associated to the GNSS antenna position to the flight deck;
d. the system should automatically remove the own-ship position symbol when the aircraft is in flight (e.g., weight on wheels, speed monitoring) and when the positional uncertainty exceeds the maximum defined value;
e. it is recommended that the AMMD detects, annunciates to the flight crew and fully removes depiction of own-ship data, in case of any loss or degradation of AMMD functions due to failures such as memory corruption, frozen system, latency, etc.;
f. the AMMD database should comply with applicable Standards for use in aviation (refer to ICAO Annex 6, Part I, 7.4 — Electronic navigation and data management); and
g. the operator should review the documents and the data provided by the AMMD developer and ensure that installation requirements of the AMMD software in the specific EFB platform and aircraft are addressed.

4.3 Flight crew training

4.3.1 The operator should define specific training in support of an AMMD’s implementation. It should be included in the operator’s overall EFB training.

4.3.2 The operations manual or user guide will provide sufficient information to flight crews, including limitations and accuracy of the system and all related procedures.

5. ELECTRONIC CHECKLIST APPLICATION

5.1 Description

5.1.1 An Electronic Checklist (ECL) is an EFB application which displays checklists to the flight crew by means of an EFB.

5.1.2 This guidance applies to:

a. ECL displaying pre-composed information or featuring a specific HMI to display the information in an optimized way to the flight crew;
b. ECL with or without capability to interact with the pilot to record the completion of the actions

and checklists;

c. ECL without capability to process information from the aircraft (e.g., Stand-alone ECL), (Capability to process information from the aircraft is more critical and not addressed by this advisory.); or

d. ECL displaying only normal checklists. (Non-normal/abnormal/emergency checklists and procedures are more critical and not addressed by this advisory.)

5.1.3 Other ECL functionalities, such as those identified in the list below, may be present in which case the TAA (DTAES staff) is responsible for the establishment of the applicable basis for compliance.

a. If the ECL receives information from the aircraft (sensed items such as aircraft system state, switch positions). The status of the sensed items may be reflected on the checklist. For example, if an action line of a checklist indicates that a button should be pressed and the aircraft sensors sense that the button has been pressed then the checklist display will indicate that the item has been accomplished.

b. If the ECL content includes non-normal (abnormal or emergency) checklists/procedures.

5.2 HMI design and Human Factors considerations

5.2.1 The ECL system (hardware, software) should provide at least the same level of accessibility, usability and reliability as a paper checklist.

5.2.2 HMI and Human Factor considerations:

a. Accessibility time for any checklist should not be longer than an equivalent paper checklist;

b. All checklists should be easily accessible for reference or review;

c. The resulting pilot actions called from an ECL should be identical to a paper checklist;

d. It should be clearly recognizable to the pilot which items or checklists are safety relevant for the operation of the aircraft, and which are of additional nature;

e. Checklists should be presented in accordance with the normal sequence of flight;

f. The title of the checklist should be displayed and distinguished at all times when in use;

g. An indication of the existence of off-screen checklist content should be provided;

h. The end of each checklist should be clearly indicated;

i. The effect of switching between ECL and other EFB applications on the same hardware should be evaluated.

5.2.3 Additional HMI and Human Factor considerations for ECL with capability to interact with the pilot to record the completion of the actions and checklists:

a. ECL should provide a checklist overview displaying which checklists are completed and which are not;

b. ECL should display the completion status of action items within a checklist;

c. If needed, it should be possible to restart a checklist. The crew should be able to reset the checklist with a verification step to confirm the restart;

d. If needed, it should be possible to uncheck an action item in a checklist.

5.4 Flight crew procedures

5.4.1 The operator should consider the impact on pilot’s workload in determining the method of use of ECL.

5.4.2 Flight crew procedures should be established to:

a. Ensure that the flight crew verifies the validity of the ECL database before use;
b. Define back-up procedure in case of loss of ECL during the flight to enable access to checklists at any time (e.g., to include scenarios regarding power loss, software malfunctions, etc.).

5.5 Administration

5.5.1 The operator should also establish a consistent and methodical process for modifying the ECL data and updated data transmission and implementation on the EFBs. Such processes should include a method for database applicability verification to individual aircraft in the operator's fleet.

5.5.2 ECL populated data content should:

a. be concise, simple, clear and unambiguous; and
b. ensure consistency between aircraft manufacturer-provided data and operator-customized data (e.g., language, terminology, acronyms).

5.6 Flight Crew Training and Documentation

5.6.1 The operator should define specific flight crew training in support of an ECL implementation. It should be included in the operator’s overall EFB training. The operating manual or user guide should provide sufficient information to flight crews including limitations of the system and all related procedures.

6.0 IN-FLIGHT WEATHER (IFW) APPLICATION

6.1. Definition

6.1.1 In the context of this advisory, in-flight weather (IFW) is an Electronic Flight Bag (EFB) function enabling the crew to access meteorological information.

6.2. Intended use and limitations

6.2.1 The introduction of IFW is supplemental to the information required by ICAO Annex 3 and does not supersede it. It should contribute to increased situational awareness and should support the flight crew when making strategic decisions.

6.2.2 The IFW application could be used to access both information required to be on board (e.g., World Area Forecast (WAFC) data), and supplemental weather information.

6.2.3 Use of IFW should be non-safety-critical and not necessary for the performance of the flight.

6.2.4 In order to be non-safety-critical, IFW should not be used to support tactical decisions and/or substitute certified aircraft systems (e.g., weather radar).

6.2.5 Information from the official flight documentation or aircraft primary systems should always prevail in case there is a contradiction with IFW information.

6.2.6 Meteorological information in IFW applications may be displayed as an overlay over aeronautical charts or geographical maps, or it may be a stand-alone weather depiction (e.g., radar plots, satellite images, etc.).

6.3. Meteorological Information considerations

6.3.1 Meteorological information can be forecasted and/or observed, and can be updated on the ground and/or in flight. It should be based on data from certified meteorological service providers or other reliable sources evaluated by the operator.

6.3.2 The meteorological information provided to the flight crew should be, as far as possible, consistent with the one available to ground-based aviation meteorological information users (e.g., Airline Operations Center (AOC), Dispatcher, etc.), in order to establish common situation awareness and to facilitate collaborative decision-making.

6.4. Display considerations

6.4.1 Meteorological information should be presented to the flight crew in a format that is appropriate to the content of the information; graphical depiction is encouraged whenever practicable.

6.4.2 Presentation should include:

a. Type of information contained in the meteorological information (i.e., observed or forecasted);
b. Currency or age and validity time of the meteorological information;
c. Information necessary for interpreting the meteorological information (e.g., legend);
d. Positive and clear indication of any missing information or data, in order for the flight crew to determine areas of uncertainty when making hazardous weather avoidance decisions.

6.4.3 If meteorological information is overlaying on aeronautical charts, special considerations should be given to Human-Machine-Interface (HMI) issues in order to avoid adverse effects on the basic chart functions.

6.4.4 Meteorological information may require reformatting for cockpit use to, for example, accommodate display size or depiction technology. However, any reformatting of meteorological information should preserve both the geo-location and intensity of meteorological conditions regardless of projection, scaling, or any other types of processing.

6.4.5 IFW display should, as far as possible, be consistent with the flight deck design philosophy in terms of location of titles, location and visual representation of legends, element size, labeling and text styles, etc.

6.4.6 It is recommended that the IFW be able to display the meteorological information in relation to the route or operational flight plan for ease of interpretation of forecasted information.

6.5. Training and Procedures

6.5.1 The operator has to specify Standard Operating Procedures specifying the use of IFW information.

6.5.2 Adequate training should be provided for the use of IFW. Training should address:

a. Limitations of the IFW, in particular those presented in section 6.2.;

b. The latency of observed weather information and the hazards associated with utilization of old information;
c. IFW information beyond Annex 3 specification and which are supplementary to the required information;
d. Use of the application;
e. Different types of displayed information (i.e., forecasted or observed);
f. Symbology (e.g., Symbols, Colors);
g. Interpretation of meteorological information;
h. Identification of failures (e.g., incomplete uplinks, datalink failures, missing info);
i. Fixation avoidance; and
j. Workload management.