## LEAFLET No. 36: APPROVAL OF ELECTRONIC FLIGHT BAGS (EFBs)

### 1. PURPOSE

The material contained in this Leaflet has been issued in accordance with Chapter 10 of the Administrative & Guidance Section 4: Operations, Part Three: Temporary Guidance Leaflets and therefore is authorised for use on voluntary basis until such time as the material has been subjected to NPA process.

### 2. SCOPE

2.1 Traditionally all documentation and information available to flight crew for use on the flight deck has been in paper format. Much of this information is now available in electronic format and the purpose of this leaflet is to give guidance to operators on gaining approval from their National Authority for the use of electronically processed information.

2.2 It is not intended to impose additional requirements in respect to basic information and data sources. The operator remains responsible for ensuring the accuracy of the information used and that it is derived from verifiable sources. The approval of EFBs is intended to cover the different methods of storing, retrieving and use of this information.

2.3 This guidance material is designed to cover airworthiness and operational criteria for the approval of Electronic Flight Bags (EFBs).

### 3. REFERENCE DOCUMENTS

#### 3.1 Related Requirements

CS/FAR 25.1301, 25.1309, 25.1316, 25.1321, 25.1322, 25.1431, 25.1581
CS/FAR 23.1301, 23.1309, 23.1321, 23.1322, 23.1431, 23.1581
CS/FAR 27.1301, 27.1309, 27.1321, 27.1322, 27.1581
CS/FAR 29.1301, 29.1309, 29.1321, 29.1322, 29.1431, 29.1581
Appendices A to CS-27 and CS-29: Instructions for Continued Airworthiness
JAR-OPS 1.110, 1.130, 1.135, 1.140, 1.150, 1.155, 1.175, 1.185, 1.200, 1.290, 1.625, 1.915, 1.920, 1.965, 1.1040, 1.1045, 1.1055, 1.1060, 1.1065, 1.1071
JAR-OPS 3.243, 3.845, 3.865 as amended by NPA-OPS-8
National operating regulations.

#### 3.2 Related Guidance Material

##### 3.2.1 JAA

| | |
|---|---|
| AMC 25.1581 | Appendix 1 – Computerised Aeroplane Flight Manual |
| INT/POL/25/14 | Human Factors Aspects of Flight Deck Design |
| TGL No. 29 | Guidance Concerning The Use Of Portable Electronic Devices On Board Aircraft. |
| EUROCAE ED-12() | Software Considerations in Airborne Systems and Equipment |
| EUROCAE ED-14() | Environmental Conditions and Test Procedures for Airborne Equipment |
| UL 1642 | Underwriters Laboratory Inc (UL) Standard for Safety for Lithium Batteries |

##### 3.2.2 FAA

| | |
|---|---|
| AC 91.21-1A | Use of Portable Electronic Devices Aboard Aircraft |
| AC 120-64 | Operational Use & Modification of Electronic Checklists |
| AC 120-74 | Flight Crew Procedures During Taxi Operations |
| AC 120-76A | Guidelines for the Certification, Airworthiness and Operational Approval of Electronic Flight Bag Computing Devices. |

| | |
|---|---|
| TSO-C165 | Electronic Map Display Equipment for Graphical Depiction of Aircraft Position |
| RTCA DO-160() | Environmental Conditions and Test Procedures for Airborne Equipment |
| RTCA DO-178() | Software Considerations in Airborne Systems and Equipment |
| RTCA DO-257A | Minimum Operational Performance Standards for the Depiction of Navigation Information on Electronic Maps |
| Volpe Center Report | Human Factors Considerations in the Design and Evaluation of Electronic Flight Bags (EFBs) Version 2 |

## 4. DEFINITIONS

**4.1 Aircraft Administrative Communications (AAC).** AAC data link receive/transmit information that includes but is not limited to, the support of applications identified in Appendices A and B of this Leaflet. Aeronautical Administrative Communications (AAC) are defined by ICAO as communications used by aeronautical operating agencies related to the business aspects of operating their flights and transport services. The airlines use the term Airline Operational Communication (AOC) for this type of communication.

**4.2 Controlled PED.** A controlled PED is Portable Electronic Device that is subject to administrative control by the company. This will include, inter alia, tracking the location of the devices to specific aircraft or persons and ensuring that no unauthorised changes are made to the hardware, software or databases. A Controlled PED will also be subject to procedures to ensure that it is maintained to the latest amendment state.

**4.3 Data Connectivity for EFB Systems.** Supporting either uni or bi-directional data communication between the EFB and the aircraft systems (e.g., avionics).

**4.4 Electronic Flight Bag (EFB).** An electronic display system intended primarily for flight deck or cabin use. EFB devices can display a variety of aviation data or perform basic calculations (e.g., performance data, fuel calculations, etc.). In the past, some of these functions were traditionally accomplished using paper references or were based on data provided to the flight crew by an operator's "flight dispatch" organisation. The scope of the EFB system functionality may also include various other hosted databases and applications. Physical EFB displays may use various technologies, formats, and forms of communication. These devices are sometimes referred to as auxiliary performance computers (APC) or laptop auxiliary performance computers (LAPC).

**4.5 EFB Administrator.** The EFB Administrator is the person appointed by the operator, held responsible for the administration of the EFB system within the company. The EFB administrator is the primary link between the operator and the EFB system supplier.

He/she will be the person in overall charge of the EFB system and will be responsible for ensuring that any hardware conforms to the required specification and that no unauthorised software is installed. He/she will also be responsible for ensuring that only the current version of the application software and data packages are installed on the EFB system.

**4.6 EFB System.** An EFB system includes the hardware and software needed to support an intended function.

**4.7 Hosted Application.** Software installed on an EFB system that allows specific operational functionality.

**4.8 Interactive Information.** Information presented on the EFB that, via software applications, could be selected and rendered in a number of dynamic ways. This includes variables in the information presented based on data-oriented software algorithms, concepts of de-cluttering, and "on-the-fly" composition as opposed to pre-composed information.

**4.9 Mounting Device.** May include arm-mounted, kneeboard, cradle, or docking-stations, etc. May have ship's power and data connectivity. May require quick-disconnect for egress.

**4.10 Portable Electronic Device (PED).** JAA TGL No. 29 and FAA Title 14 CFR § 91.21 define PEDs.

**4.11 Pre-Composed Information.** Information previously composed into a static composed state (non-interactive). The composed displays have consistent, defined and verifiable content, and formats that are fixed in composition. Applications based on pre-composed information may support "contextual access" like hyperlink, bookmark.

## 5. SYSTEM DESCRIPTION AND CLASSIFICATION OF EFB Systems

This section is divided into two parts. The first part deals with the host platform i.e. the hardware used to run the software programs and the second part deals with the software programs or applications installed to provide the relevant functionality. For information, a matrix showing the relationship between airworthiness and operational approval processes is provided in Appendix E.

### 5.1 Hardware Classes of EFB Systems

This Leaflet defines three hardware classes of EFB systems, Class 1, 2, and 3.

#### 5.1.1 Class 1

Class 1 EFB systems are:

- Generally Commercial-Off-The-Shelf (COTS)-based computer systems used for aircraft operations,
- Portable,
- Connect to aircraft power through a certified power source,
- Not attached to an aircraft mounting device,
- Considered as a controlled PED,
- Normally without aircraft data connectivity except under specific condition (see Section 6),
- Class 1 EFB systems do not require airworthiness approval.

#### 5.1.2 Class 2

Class 2 EFB systems are:

- Generally COTS-based computer systems used for aircraft operations,
- Portable,
- Connect to aircraft power through a certified power source,
- Connected to an aircraft mounting device during normal operations,
- Considered as a controlled PED,
- Connectivity to Avionics is possible,
- Class 2 EFB systems require airworthiness approval as described in Section 6.

#### 5.1.3 Class 3

Class 3 EFB systems are installed equipment requiring an airworthiness approval. This approval should cover the integrity of the EFB hardware installation (e.g. server, display, keyboard, power, switching), including hardware and software qualification. Such aspects as the human machine interface should also be addressed.

### 5.2 Software Applications for EFB Systems

The functionality associated with the EFB System depends upon the applications loaded on the host. The classification of the applications into two Types (A and B) is intended to provide clear divisions between the scope and therefore the approval process applied to each one. Although guidelines and examples are provided in this leaflet to provide guidance as to the Type associated with a particular

application, there is still the potential for misclassification. Applicants should be aware of two particular issues. The Type of application will influence the level of participation of the operations authority i.e. National Authority Flight Operations Inspectorate (FOI) or Joint Operational Evaluation Board (JOEB) and indeed the involvement or otherwise of the airworthiness authorities in the assessment exercise. For example, a misclassification may later be shown to have impacted the underlying airworthiness approval granted for the aircraft systems. In particular where there is data connectivity or interactive information the assumptions made by the Original Equipment Manufacturer (OEM) during initial certification may no longer hold e.g. data integrity, accuracy of performance calculations, primary use versus situational use. Therefore, if there is any doubt as to the classification of an application, applicants should seek advice early on in the approval process from either the respective JOEB Team or Central JAA Operations Directorate.

### 5.2.1 Type A

Type A software applications include pre-composed, fixed presentations of data currently presented in paper format. Type A software applications:

- May be hosted on any of the hardware classes
- Require Operational approval. This may be undertaken at the National Authority FOI level.
- Do not require an airworthiness approval
- Typical examples of Type A software applications may be found in Appendix A.

### 5.2.2 Type B

Type B software applications include dynamic, interactive applications that can manipulate data and presentation. Type B applications:

- May be hosted on any of the hardware classes
- Require Operational approval. This will be undertaken at the JOEB level or where a JOEB does not exist for the particular aircraft type, the Central JAA may delegate to a National Authority FOI.
- Do not require an airworthiness approval
- Typical examples of Type B software applications may be found in Appendix B.

## 6. AIRWORTHINESS APPROVAL

The following airworthiness criteria are applicable to EFB installation.

### 6.1 EFB Hardware Approval Process (Host Platform)

### 6.1.1 Class 1 EFB

A Class 1 EFB does not require an airworthiness approval because it's a non-installed equipment however paragraph 6.1.1.a) through 6.1.1.d) here below should be assessed if relevant. During the operational approval process an assessment should be made of the physical use of the device on the flight deck. Safe stowage, crashworthiness, security and use under normal environmental conditions including turbulence should be addressed.

**a) EMI Demonstrations**
For the purpose of EMI demonstrations, EFB Class 1 devices may be considered as PEDs and should satisfy the criteria contained within TGL No. 29 or AC 91.21-1A. If the EFB system is to be used during critical phases of flight (e.g., during take-off and landing), further EMI demonstrations (laboratory, ground or flight test) are required to provide greater assurance of non-interference and ensure compatibility. For use during critical flight phases, the EFB system should comply with the requirements of ED-14()/DO-160() Section 21, Emission of Radio Frequency Energy.

**b) Lithium Batteries**
During the procurement of Class 1 EFBs, special considerations should be given to the intended use and maintenance of devices incorporating lithium batteries. In particular, the operator should address the following issues:

- Risk of leakage
- Safe storage of spares including the potential for short circuit
- Hazards due to on-board continuous charging of the device, including battery overheat

As a minimum specification, the lithium battery incorporated within the EFB device should have been tested to Underwriters Laboratory Inc (UL) Standard for Safety for Lithium Batteries reference UL 1642. The operator is responsible for the maintenance of EFB system batteries and should ensure that they are periodically checked and replaced when required.

**c) Power Source**
The EFB power source should be designed such that it may be deactivated at any time. Where there is no possibility for the flight crew to quickly remove or un-plug the power to the EFB system, a clearly labelled and conspicuous means (e.g., on/off switch) should be provided. Circuit breakers are not to be used as switches; their use for this purpose is prohibited.

In order to achieve an acceptable level of safety, certain software applications, especially when used as a source of required information, may require that the EFB system have access to an alternate power supply.

**d) Data Connectivity**
Data connectivity to other systems is not authorised except if connected to a system completely isolated from the avionics/aircraft systems (e.g., EFB system connected to a transmission media that receives and transmits data for AAC purposes on the ground only). Any other type of data connectivity requires an airworthiness approval.

### 6.1.2 Class 2 EFB

A Class 2 EFB requires an airworthiness approval. However, this approval is limited in scope to the mounting device, crashworthiness, data connectivity and EFB power connection.

An evaluation of the EFB mounting device and flight deck location should be conducted as described below:

**a) Design of Mounting Device**
The mounting device (or other securing mechanism) that attaches or allows mounting of the EFB system, may not be positioned in such a way that it obstructs visual or physical access to aircraft controls and/or displays, flight crew ingress or egress, or external vision. The design of the mount should allow the user easy access to the EFB controls and a clear view of the EFB display while in use. The following design practices should be considered:

(i) The mount and associated mechanism should not impede the flight crew in the performance of any task (normal, abnormal, or emergency) associated with operating any aircraft system.

(ii) Mounting devices should be able to lock in position easily. Selection of positions should be adjustable enough to accommodate a range of flight crewmember preferences. In addition, the range of available movement should accommodate the expected range of users' physical abilities (i.e., anthropometrics constraints). Locking mechanisms should be of the low-wear type that will minimize slippage after extended periods of normal use. Crashworthiness considerations will need to be considered in the design of this device. This includes the appropriate restraint of any class device when in use.

(iii) A provision should be provided to secure or lock the mount in a position out of the way of flight crewmember operations when not in use.

(iv) Mechanical interference issues of the mount, either on the side panel (side stick controller) or on the control yoke in terms of full and free movement under all operating conditions and non-interference with buckles etc. For yoke mounted devices Original Equipment Manufacturer (OEM) data should be obtained to show that the mass inertia effect on column force has no adverse affect on the aircraft handling qualities.

(v) If the EFB requires cabling to mate with aircraft systems or other EFBs, and if the cable is not run inside the mount, the cable should not hang loosely in a way that compromises task performance and safety. Flight crewmembers should be able to easily secure the cables out of the way during aircraft operations (e.g., cable tether straps).

(vi) Cables that are external to the mount should be of sufficient length to perform the intended tasks. Cables too long or short could present an operational or safety hazard.

**b) Placement of Mounting Device**

The device should be mounted so that the EFB is easily accessible when stowed. When the EFB is in use (intended to be viewed or controlled), it should be within 90 degrees on either side of each pilot's line of sight. This requirement does not apply if the information is not being directly monitored from the EFB during flight. For example, an EFB may generate takeoff and landing V-speeds, but these speeds are used to set speeds bug or are entered into the FMS, and the airspeed indicator is the sole reference for the V-speeds. In this case, the EFB system need not be located in the pilot's primary field of view. A 90-degree viewing angle may be unacceptable for certain EFB applications if aspects of the display quality are degraded at large viewing angles (e.g., the display colours wash out or the displayed colour contrast is not discernible at the installation viewing angle). In addition, consideration should be given to the potential for confusion that could result from presentation of relative directions (e.g., positions of other aircraft on traffic displays) when the EFB is positioned in an orientation inconsistent with that information. For example, it may be misleading if own aircraft heading is pointed to the top of the display and the display is not aligned with the aircraft longitudinal axis. Each EFB system should be evaluated with regard to these requirements. (See CS-23.1321 and CS-25.1321.)

**c) EMI Demonstrations, Lithium Batteries, Power Source**

In respect of the EMI demonstrations, use of lithium batteries and power source, see Paragraphs 6.1.1 a), b) and c) above.

**d) EFB Data Connectivity**

EFB data connectivity should be validated and verified to ensure non-interference and isolation from aircraft systems during transmission and reception.

### 6.1.3 Class 3 EFB

A Class 3 EFB is considered as installed equipment and therefore requires an airworthiness approval. Assessment of compliance with the airworthiness requirements would typically concentrate on two areas:

- The intended function and safety (e.g., security and integrity), applicable only to the interfaces with the avionics data sources and not to the software applications. The failure modes of the interface between the EFB and its avionics data sources should be assessed under normal and fault conditions. The assessment of safety and integrity of the software application should be addressed through the approval of the application itself (see Section 6.2).
- Hardware and software qualification should be conducted in accordance with the agreed Design Assurance Level (DAL) for the system and its interfaces. Note: DAL attribution at this stage (empty platform) may prohibit hosting of future software applications due to inconsistency between the criticality of the future software application and the platform DAL.

A Class 3 EFB may form part of a host platform (i.e., a network server) supporting other functions such as central maintenance. Such functions are considered to be outside of the scope of this leaflet and their approval should be conducted in accordance with normal certification procedures.

For a Class 3 EFB a human factors assessment should be conducted. At this stage the evaluation is restricted to the EFB hardware resources comprising display, keyboard, switches, annunciators, etc. However, in order to assess the human factors aspects of these devices, it may be necessary to host emulation software on the platform. This may be a dedicated software package developed purely for the purposes of conducting the assessment or be one or more of the intended EFB software applications. The human factors assessment should be conducted in accordance with the criteria applied during the aircraft type design or modification exercise and identified within the aircraft

certification basis. If no prior human factors requirements have been applied, the applicant should follow the process described in Appendix D.

### 6.1.4 Certification Documentation

**a) Aircraft Flight Manual**

For Class 2 and 3 EFB the Aircraft Flight Manual (AFM) should contain any limitations affecting the use of the EFB system e.g., a statement that a particular function is not intended as a primary navigation reference. Note: under certain circumstances a placard mounted adjacent to the EFB display might also be warranted. The AFM should also make reference to any applicable guidelines for application developers, operators and national authorities – see chapter 6.1.4.b below.

**b) Guidelines for EFB Application Developers**

The guideline document should provide a set of requirements and guidelines to design, develop and integrate software applications into the EFB host platform. It is intended primarily for use by software application developers, but may also be of use to the operator and the JOEB and/or National Authority. The guideline should address at least the following:

- A description of the architecture for the host platform
- Information necessary in order to define a software application, including library routines etc.
- The EFB Design Assurance Level (DAL) and any assumptions, limitations or risk mitigations made in support of this
- Information necessary to ensure development of a software application consistent with the avionics interface and the human machine interface, that is also accurate, reliable, secure, testable, and maintainable
- Rules of co-habitation of any new software application with those already approved
- Guidelines on how to integrate any new software application into the platform
- A quality assurance process for developing software applications in the context of the host platform

### 6.2 EFB Software Applications (Type A and B)

Type A and B software applications do not require airworthiness approval, but should be approved through the operational approval process. Examples of Type A and Type B software applications, based mainly on FAA AC 120-76A, are given in Appendix A and B of this leaflet respectively. Some differences with FAA AC 120-76A have been introduced and are highlighted in these appendices. If a software application is not listed in these appendices and does not clearly fall into the existing definitions of Section 5.2, advice should be sought from the Central JAA or relevant JOEB Team, or the responsible National Authority.

**a) Applications Ineligible for Type A or Type B EFB Classification**

It should be noted that, unlike FAA AC 120-76A, this Leaflet does not include a Type C software application classification. The JAA policy is that any software application not falling within the scope of Type A or Type B should undergo a full airworthiness approval. This is consistent with the FAA policy for Type C software applications under the Advisory Circular, but eliminates the confusion of what is Type C EFB and what is normal aircraft function. This has been a particular issue with Class 3 hardware platforms where other non-EFB functions may be hosted requiring separate airworthiness approval. By removing Type C, in terms of airworthiness assessment all non Type A and Type B software applications are treated the same as non-EFB functions. Examples of software applications that the JAA consider to be ineligible for Type A or Type B EFB classification are provided in Appendix C.

**b) Specific Considerations for Performance and Electronic Checklist Applications**

Although the airworthiness authority is not directly involved in the approval of Type B software applications such as performance calculations (weight & balance, take-off and landing performance) and electronic checklist, they may become indirectly involved.

Performance applications are typically derived from Computerised AFM Information, approved against the applicable airworthiness regulations. Only certain modules of the performance program are

approved, and then against a particular program revision and a particular host e.g., Personal Computer. With performance Type B software applications the operations authority (JOEB or National Authority) requires assurance that the resulting data, through software derivation, customisation or optimisation, provides performance figures that are consistent with the approved computerised aircraft flight manual information. If there is any concern, the operations authority may wish to seek advice from airworthiness performance specialists to assist in the validation of these types of software application. In general, this involves checking that the EFB derived performance calculations provides consistent results when compared with calculations from the approved AFM modules.

With electronic checklists, there is already regulatory guidance material published on the subject e.g., FAA AC 120-64. The concern here is where the EFB software application is customised or changed through the user-modifiable partition such that the electronic checklist differs from the approved procedures contained within the AFM. Of particular concern are changes affecting the approved Abnormal and Emergency Procedures. Again, where there are concerns, the operations authority should consult with the respective airworthiness authority team.

## 7 OPERATIONAL APPROVAL

The Authority will consider applications from operators to use an EFB system on a case-by-case basis using the process described hereafter. Operators planning to implement the use of EFB systems will need to demonstrate to the Authority that the EFB system is robust and will not provide inaccurate or misleading information to crews.

The operator may demonstrate the fidelity and reliability of the system in a number of ways. Where it is the intention to start EFB operations with no paper back up a full Operational Risk Assessment and suitable means of mitigation against failure or malfunction will be required. Alternatively, the operator may choose to keep the paper back up, as a cross check against the EFB information and as a means of mitigation against failure or malfunction. A combination of the above methods where some risk assessment and limited paper back up is carried may also be used at the discretion of the authority. The final Operational Evaluation Test (see section 7.7) will depend on the method used.

Note: Where the term Authority is used in this Section, it applies to either the JOEB or the National Authority depending on who has primary responsibility for conducting the assessment. Ultimately an individual operator would expect to receive an operational approval from their National Authority.

### 7.1 Operational Risk Analysis

The Authority will need to be satisfied that the operator has considered the failure of the complete EFB system as well as individual applications including corruption or loss of data and erroneously displayed information.

The objective of this process is to demonstrate that the software application achieves at least the same level of integrity and availability as the “traditional” means that it is intended to replace

#### 7.1.1 Scope

The analysis will be specific to the operator concerned but will need to address at least the following points:

- Minimisation of undetected erroneous application output
- Ease or otherwise to detect erroneous outputs from the software application
    - Description of corruption scenarios
    - Description of mitigation means (crew monitoring)

- Upstream development quality process
    - Reliability of root data used in applications (qualified/verified input data)
    - Application verification and validation checks

  - Partitioning of application software having safety effect from application software without safety effect e.g., partitioning of Type A, B from other application.

- Description of the mitigation means following detected loss of application, or detected erroneous output due to internal EFB error e.g., availability of back up data, procedures etc. This may be in the form of an alternative EFB possibly supplied from a different power source or some form of paper back up system e.g., Quick Reference Handbook (QRH).

The operator may then propose to the Authority that the EFB system be used as an alternative system to paper documentation. The proposal to the Authority should specify which paper documentation need not be carried and/or any operational credit sought. The Authority may require a trial period during which paper documentation is retained to confirm the robustness of the system.

The impact of the EFB system on the Minimum Equipment List (MEL) should be assessed. The operator should demonstrate how the availability of the EFB is confirmed by pre-flight checks. Instructions to flight crew should clearly define actions to be taken in the event of any EFB system deficiency and whether dispatch is allowed.

### 7.2 Human Machine Interface Assessment for Type A and B Software Applications

The operator will need to carry out an assessment of the human machine interface and aspects governing Cockpit Resource Management (CRM), when using the EFB system. This should include a review of the complete system to include at least the following points.

- Human/machine interface
- Legibility of text
- Approach/departure and navigation chart display
- Responsiveness of application
- Off-screen text and content
- Active regions
- Managing multiple open applications and documents
- Messages and the use of colours
- System error messages
- Data entry screening and error messages

Note: Further guidance and means of compliance are provided in Appendix D.

### 7.3 Flight Crew Operating Procedures.

#### 7.3.1 Procedures for Using EFB Systems with other Flight Deck Systems

Procedures should be designed to ensure that the flight crew know which aircraft system (e.g., Engine Indicating and Crew Alerting System (EICAS), Flight Management System (FMS), or EFB system) to use for a given purpose, especially when both the aircraft and EFB systems provide similar information. Procedures should also be designed to define the actions to be taken when information provided by an EFB system does not agree with that from other flight deck sources, or when one EFB system disagrees with another. If an EFB system generates information similar to that generated by existing cockpit automation, procedures should clearly identify which information source will be primary, which source will be used for back up information, and under what conditions to use the back up source. Whenever possible and without compromising innovation in design/use, EFB/user interfaces should be consistent (but not necessarily identical) with the flight deck design philosophy.

#### 7.3.2 Flight Crew Awareness of EFB Software/Database Revisions

The operator should have a procedure in place to allow flight crews to confirm prior to flight the revision number and/or date of EFB application software including where applicable, database versions. However, flight crews should not be required to confirm the revision dates for other databases that do not adversely affect flight operations, such as maintenance log forms, a list of airport codes, or the Captain's Atlas. An example of a date sensitive revision is an aeronautical chart

database on a 28-day AIRAC revision cycle. Procedures should specify what actions to take if the software applications or databases loaded on the EFB system are out-of-date.

### 7.3.3 Procedures to Mitigate and/or Control Workload

Procedures should be designed to mitigate and/or control additional workloads created by using an EFB system. The operator should develop procedures such that both flight crewmembers do not become preoccupied with the EFB system at the same time. Workload should be apportioned between flight crewmembers to ensure ease of use and continued monitoring of other flight crew functions and aircraft equipment. These procedures should be strictly applied in flight and should specify the times at which the flight crew may not use the EFB system.

### 7.3.4 Defining Flight Crew Responsibilities for Performance Calculations

Procedures should be developed that define any new roles that the flight crew and dispatch office may have in creating, reviewing, and using performance calculations supported by EFB systems.

## 7.4 Quality Assurance

The operator should document procedures for the quality control of the EFB system. This should detail who will be in overall charge of the EFB system, i.e. the EFB Administrator, and who will have authority to authorise and activate amendments to the hardware and software.

Procedures should be established for the maintenance of the EFB system and how unserviceabilities and failures will be dealt with to ensure that the integrity of the EFB system is assured. Maintenance procedures will also need to include the handling of updated information and how this will be accepted and then promulgated in a timely and complete format to all users and aircraft platforms.

Should a fault or failure of the system come to light it is essential that such failures are brought to the immediate attention of the flight crew and that the system is isolated until rectification action is taken. As well as back up procedures to deal with system failures a reporting system will need to be in place so that any action necessary, either to a particular EFB system, or to the whole system, is taken in order to prevent the use of erroneous information by flight crews.

The EFB system will need to be secure from unauthorised intervention. This should include the use of password protected system updates as well as physical security of the hardware. Measures should also include the control of laptop software installations to prevent use of unauthorised data.

## 7.5 Role of the EFB Administrator

The role of the EFB Administrator is a key factor in the running of the EFB system. He/she will need to receive appropriate training in the role and should have a good working knowledge of the proposed system hardware and operating system. The EFB system supplier should provide guidelines to clearly identify, which parts of the system can be accessed and modified by the EFB Administrator and which parts are only accessible by the supplier. It should also be clearly stated which changes and modifications may be further delegated by the EFB Administrator to maintenance and support staff. The EFB Administrator should establish procedures to ensure that these guidelines are strictly adhered to and that no unauthorised changes take place. The EFB Administrator will also be responsible for conducting audits and for ensuring that company procedures are complied with by all personnel. This should include systematic audits/checks against the procedures and random checks of reports to ensure that any detected errors are correctly followed up.

## 7.6 Flight Crew Training

Flight crew will need to be given specific training in the use of the EFB system before any approval is given. Training should include at least the following:

- An overview of the system architecture

- Pre-flight checks of the system
- Limitations of the system
- Specific training on the use of each application and the conditions under which the EFB may and may not be used
- Restrictions on the use of the system, including where some or all of the system is not available
- Procedures for cross checking of data entry and computed information
- Phases of flight when the EFB system may and may not be used
- CRM and human factor considerations on the use of the EFB
- Additional training for new applications or changes to the hardware configuration

Consideration should also be given to the role that the EFB system plays in Operator Proficiency Checks as part of Recurrent training and checking.

### 7.7 Operational Evaluation Test

The object of the Operational Evaluation Test will be to verify that the above elements have been satisfied before final approval of the EFB in place of paper documentation.

#### 7.7.1 Initial Retention of Paper Back Up

Where paper is initially retained as back up, the operational evaluation test will typically be conducted in two stages. The first stage should run in parallel with the equivalent paper format to verify the correctness and reliability of the system. This will normally be for a six-month period but may be varied at the discretion on the National Authority. The evaluation should include audits of the procedures used as well as checks on the accuracy of any computed data. On completion of the first stage a report should be sent to the National Authority who will then issue an approval for the use of the system in place of the paper format. As a precaution, the paper documentation must be retained during a second stage for use in the event of the EFB system not being available or any fault being detected with the system. When the National Authority is satisfied that the back-up procedures are sufficiently robust, approval may be given to allow removal of the paper documentation.

#### 7.7.2 Commencement of Operations without Paper Back Up

Where the applicant / operator seeks credit to start of operations without paper back up the operational evaluation test will consist of the following elements:

- A detailed review of the operational risk analysis
- A simulator LOFT session to verify the use of the EFB under operational conditions including normal, abnormal and emergency conditions. Items such as a late runway change and diversion to an alternate should also be included. This should be conducted before any actual line flights, as the outcome may need a change to the flight crew training and/or administrative procedures.
- Observation by the authority of the initial line flights.

The authority must also be satisfied that operator will be able to continue to maintain the EFB to the required standard through the actions of the administrator and quality assurance system.

### 7.8 Final Operational Report (Operational Compliance Summary)

The operator should produce a final operational report, which summarises all activities conducted as demonstrated means of compliance, supporting the issue of an operational approval of the EFB system.
The report should include, but not be limited to, the following:

- EFB platform/hardware description
- Description of each software application to be included in the approval
- Risk analysis summary for each application and mitigation means put in place

- Human factor assessment for the complete EFB system, human machine interface and all software applications
    - Pilot workload in both single-pilot and multi-crew flown aircraft
    - Size, resolution, and legibility of symbols and text
    - For navigation chart display: access to desired charts, access to information within a chart, grouping of information, general layout, orientation (e.g., track-up, north-up), depiction of scale information.
- Training
- EFB Administrator qualification

Once the Authority is satisfied that the EFB may be used in place of, or as an alternative to paper based information, it will issue an approval based on the submission described above.

## Appendix A Examples of Type A Software Applications

Based on FAA AC 120-76A. Differences from AC 120-76A are highlighted in bold text.

- Flight Crew Operations Manuals (FCOM) ***(Without contextual access based on sensed aircraft parameters)***
- Company Standard Operating Procedures (SOP)
- Airport diversion policy guidance, including a list of Special Designated Airports and/or approved airports with emergency medical service (EMS) support facilities
- Operations Specifications (OpSpecs)
- Cockpit observer briefing cards
- Airplane Flight Manuals (AFM) and Airplane Flight Manual Supplements (AFMS)
- Aircraft performance data (fixed, non-interactive material for planning purposes)
- Airport performance restrictions manual (such as a reference for takeoff and landing performance calculations)
- Maintenance manuals
- Aircraft maintenance reporting manuals
- Aircraft flight log and servicing records
- Autopilot approach and autoland records
- Flight Management System/Flight Management and Guidance System problem report forms
- Aircraft parts manuals
- Service bulletins/published Airworthiness Directives, etc.
- Air Transport Association (ATA) 100 format maintenance discrepancy write-up codes
- Required VHF Omni directional Range (VOR) check records
- Minimum Equipment Lists (MEL) ***(Without contextual access based on sensed aircraft parameters)***
- Configuration Deviation Lists (CDL)
- Federal, state, and airport-specific rules and regulations
- Airport/Facility Directory (A/FD) data (e.g., fuel availability, LAHSO distances for specific runway combinations, etc.)
- Noise abatement procedures for arriving and departing aircraft
- Published (graphical) pilot Notices to Airmen (NOTAM)
- International Operations Manuals, including regional supplementary information and International Civil Aviation Organization (ICAO) differences
- Aeronautical Information Publications (AIP)
- 
- Oceanic navigation progress logs
- Pilot flight and duty-time logs
- Captain's report (i.e., captain's incident reporting form)
- Flight crew survey forms (various)
- Cabin Staff Manuals
- EMS reference library (for use during medical emergencies)
- Trip scheduling and bid lists
- Aircraft's captain's logs
- Aircraft's CAT II/CAT III landing records
- Antiterrorism profile data
- Hazardous Materials (HAZMAT)/oxidizer look-up tables
- Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods (ICAO Doc 9481-AN/928)
- Customs declaration
- Special reporting forms, such as Safety Reports, Airprox and Bird Strike reports.
- Incidents of interference to aircraft electronic equipment from devices carried aboard aircraft
- Current fuel prices at various airports
- Aircraft operating and information manuals
- Flight operations manuals including emergency procedures
- Airline policies and procedures manuals
- Aircraft Maintenance Manuals

- Flight crew qualifications record keeping, including aircraft qualifications, CAT II/III, high minimums, landing currency, flight and duty time, etc.
- PIC currency requirements
- ***Weather information in a pre-composed format***

## Appendix B Examples of Type B Software Applications

Based on FAA AC 120-76A with additional notes highlighting potential need for airworthiness authority involvement during the operational approval process.

- Flight Crew Operations Manuals (FCOM) with contextual access based on sensed aircraft parameters
- Takeoff, en route, approach and landing, missed approach, go-around, etc., performance calculations. Data derived from algorithmic data or performance calculations based on software algorithms [1]
- Power settings for reduced thrust settings [1]
- Runway limiting performance calculations [1]
- Weight and balance calculations [1]
- Minimum Equipment Lists (MEL) with contextual access based on sensed aircraft parameters
- Panning, zooming, scrolling, and rotation for approach charts
- Pre-composed or dynamic interactive electronic aeronautical charts (e.g., en route, area, approach, and airport surface maps) including, centring and page turning but without display of aircraft/own-ship position [2]
- Electronic checklists, including normal, abnormal, and emergency (Without contextual access based on sensed aircraft parameters) [3]
- Applications that make use of the Internet and/or other aircraft operational communications (AAC) or company maintenance-specific data links to collect, process, and then disseminate data for uses such as spare parts and budget management, spares/inventory control, unscheduled maintenance scheduling, etc. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly)
- Weather ***information with graphical interpretation***
- Cabin-mounted video and aircraft exterior surveillance camera displays

[1] Performance computation application including pre-composed and interactive data may be classified as a Type B, subject to consultation and agreement with the responsible airworthiness authority during the operational approval process. Otherwise, such applications should follow a normal airworthiness approval process.

[2] Dynamic interactive charts may need to follow a normal airworthiness approval process if functionality, accuracy, refresh rate and resolution enable to use this application as a navigation display.

[3] Electronic checklist may be classified as a Type B, subject to consultation and agreement with the responsible airworthiness authority during the operational approval process. Otherwise, such applications should follow a normal airworthiness approval process.

## Appendix C Applications Ineligible for Type A or Type B EFB Classification

When classifying the EFB Type, it is important that software applications are correctly classified and the appropriate level of airworthiness and operational assessment is clearly identified. Appendices A and B of this Leaflet list software applications which may be classified as either Type A or Type B and which may be approved through an operational approval process. The distinction between Type B and a software application that should undergo a normal airworthiness process is more difficult and will require negotiation between the applicant and the relevant JOEB Team / Central JAA or National Authority. The Notes within Appendix B are intended to highlight those applications that may require airworthiness review prior to operational approval.

The list below includes software applications that are considered by the JAA to be ineligible for classification as either Type A or B and will need to go through a full airworthiness approval process:

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

Note 1: the wording "may directly be used by the flight crew" in the above criteria is intended to assess the potential use by the crew considering the functional capability of the application.
Note 2: applications covered by an airworthiness approval may contain user-modifiable software or data. The boundaries of the user-modifiable parts should be defined as part of the airworthiness approval.
Note 3: In case of doubt on the applicability of the above criteria, the application developer should contact the responsible authority and seek advice.

## Appendix D Human Machine Interface Assessment and Human Factors Considerations

### D1 General Principles

This appendix provides guidance material for the assessment of the human machine interface associated with the EFB system. It provides general criteria that may be applied during assessments conducted during both the airworthiness and operational approvals and is restricted to human factors assessment techniques and means of compliance. The process for division of responsibilities and who does what, is contained within the main body of the Leaflet. Note: Where an assessment is conducted as part of an airworthiness approval i.e. for a Class 3 EFB system, JAA INT/POL/25/14 titled Human Factors Aspects of Flight Deck Design, should be applied.

### D2 Common Considerations

#### D2.1 Human Machine Interface

The EFB system should provide a consistent and intuitive user interface, within and across the various hosted applications. This should include, but not be limited to, data entry methods, colour-coding philosophies, and symbology.

#### D2.2 Legibility of Text

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

#### D2.3 Input Devices

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.

#### D2.4 General EFB design guidelines

**D2.4.1 Messages and the Use of Colours.** For any EFB system, EFB messages and reminders should meet the requirements in CS 23.1322 or 25.1322, as is appropriate for the intended aircraft. While the regulations refer to lights, the intent should be generalised to extend to the use of colours on displays and controls. That is, the colour “red” shall be used only to indicate a warning level condition. “Amber” shall be used to indicate a caution level condition. Any other colour may be used for items other than warnings or cautions, providing that the colours used, differ sufficiently from the colours prescribed to avoid possible confusion. EFB messages and reminders should be integrated with (or compatible with) presentation of other flight deck system alerts. EFB messages, both visual and auditory, should be inhibited during critical phases of flight. Flashing text or symbols should be avoided in any EFB application. Messages should be prioritised and the message prioritisation scheme evaluated and documented. Additionally, during critical phases of flight, required flight information should be continuously presented without un-commanded overlays, pop-ups, or pre-emptive messages, excepting those indicating the failure or degradation of the current EFB application. However, if there is a regulatory or Technical Standard Order (TSO) requirement that is in conflict with the recommendation above, those should have precedence.

**D2.4.2 System Error Messages.** If an application is fully or partially disabled, or is not visible or accessible to the user, it may be desirable to have a positive indication of its status available to the

user upon request. Certain non-essential applications such as e-mail connectivity and administrative reports may require an error message when the user actually attempts to access the function rather than an immediate status annunciation when a failure occurs. EFB status and fault messages should be prioritised and the message prioritisation scheme evaluated and documented.

**D2.4.3 Data Entry Screening and Error Messages.** If user-entered data is not of the correct format or type needed by the application, the EFB should not accept the data. An error message should be provided that communicates which entry is suspect and specifies what type of data is expected. The EFB system 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.

### D2.5 Error and Failure Modes

**D2.5.1 Flight Crew Error.** The system should be designed to minimise the occurrence and effects of flight crew error and maximise 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, colour-coding philosophies and symbology should be as consistent as possible across the various hosted EFB applications. These applications should also be compatible with other flight deck systems.

**D2.5.2 Identifying Failure Modes.** The EFB system should be capable of alerting the flight crew of probable EFB system failures.

### D2.6 Responsiveness of Application

The system should provide feedback to the user when user input is accepted. If the system is busy with internal tasks that preclude immediate processing of user input (e.g., calculations, self-test, or data refresh), the EFB should display a “system busy” indicator (e.g., clock icon) to inform the user that the system is occupied and cannot process inputs immediately.

The timeliness of system response to user input should be consistent with an application’s intended function. The feedback and system response times should be predictable to avoid flight crew distractions and/or uncertainty.

### D2.7 Off-Screen Text and Content

If the document segment is not visible in its entirety in the available display area, such as during “zoom” or “pan” operations, the existence of off-screen content should be clearly indicated in a consistent way. For some intended functions it may be unacceptable if certain portions of documents are not visible. 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.

### D2.8 Active Regions

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

### D2.9 Managing Multiple Open Applications and Documents

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.

### D2.10 Flight Crew Workload

The positioning, of the EFB should not result in unacceptable flight crew workload. Complex, multi-step data entry tasks should be avoided during takeoff, landing, and other critical phases of flight. An evaluation of EFB intended functions should include a qualitative assessment of incremental pilot workload, as well as pilot system interfaces and their safety implications

## D3 Specific Application Considerations

### D3.1 Approach/Departure and Navigation Chart Display

The approach, departure, and navigation charts that are depicted should contain the information necessary, in appropriate form, to conduct the operation to at least a level of safety equivalent to that provided by paper charts. It is desirable that the EFB display size is at least as large as current paper approach charts and that the format be consistent with current paper charts. Alternate approach plate presentations may be acceptable, but will need to be evaluated and approved by the Authority for functionality and human factors.

## Appendix E EFB classification matrix and derived certification and operational approval

This appendix provides a matrix showing the relationship between the respective airworthiness and operational approval processes for all EFB Classes and Types.

| EFB Applications | Hardware Class | Airworthiness Involvement (Section 6) | Operational Involvement (Section 7) |
|---|---|---|---|
| Type A<br>Refer to<br>Appendix A | Class 1,2,3 | 1) Class 1: No<br>2) Class 2: Yes, for<br>• Mounting device<br>• Power<br>• Data Connectivity<br>3) Class 3: Yes for the EFB installation and human factor aspects<br>4) Type A: No | National Authority FOI:<br>• Risk Analysis<br>• Human Factor assessment<br>• Quality Assurance<br>• System Administration<br>• Crew Training<br>• Operational Evaluation Test<br>• Statement approval |
| Type B<br>Refer to<br>Appendix B | Class 1,2,3 | 1) Class 1: No<br>2) Class 2: Yes, for<br>• Mounting device<br>• Power<br>• Data Connectivity<br>3) Class 3: Yes for the EFB installation and human factor aspects<br>4) Type B: No* | JOEB or Central JAA who may delegate to a nominated National Authority FOI:<br>• Risk Analysis<br>• Human Factor assessment<br>• Quality Assurance<br>• System Administration<br>• Crew Training<br>• Operational Evaluation Test<br>• Final report |
| | | | |

* Subject to consultation and agreement with the responsible airworthiness authority during the operational approval process, see Appendix B.