REPUBLIC OF KENYA

KENYA CIVIL AVIATION AUTHORITY

efficiently managing air safety

ELECTRONIC FLIGHT BAG MANUAL

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FORWARD

This Electronic Flight Bag Manual has been prepared for use by both the Authority and Operators seeking approval and or authorisation for use of on board EFB.

The manual contains the required approval process, operations and maintenance required processes.

In addition, the flight crew training (crew to be used), operating procedures has been addressed.

DIRECTOR AVIATION SAFETY, STANDARDS AND REGULATION

RECORD OF REVISIONS

Change Summary

Issue No.	Brief Description of Change	Prepared by	Effective Date

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REFERENCES

Civil Aviation (Operation of Aircraft for Commercial Air Transport) Regulations 128, 2013	Equipment
Civil Aviation (Operation of Aircraft for Commercial Air Transport) Regulations 129, 2013	Functions
Civil Aviation (Operation of Aircraft for Commercial Air Transport) Regulations 130, 2013	Operational Approval

ICAO Doc 10020 - Electronic Flight Bag

CHAPTER 1

1.0 EQUIPMENT/HARDWARE CONSIDERATIONS

1.1 TYPES OF EFBs

EFBs can be either portable or installed (i.e. part of the aircraft definition).

Portable EFBs are not part of the aircraft configuration and are considered as PEDs. They generally have self-contained power and may rely on data connectivity to achieve full functionality. Modifications to the aircraft to use portable EFBs require the appropriate airworthiness approval depending on the State's regulatory framework.

Installed EFBs are integrated into the aircraft, subject to normal airworthiness requirements and under design control. The approval of these EFBs is included in the aircraft's type certificate (TC) or in a supplemental type certificate (STC).

1.2 HARDWARE CONSIDERATIONS FOR INSTALLED RESOURCES AND MOUNTING DEVICES

Installed resources should be certified either during the certification of the aircraft, through service bulletins by the original equipment manufacturer (OEM), or through a third-party STC.

1.2.1 Mounting devices

If the mounting is permanently attached to the aircraft structure, the installation will be approved in accordance with the appropriate airworthiness regulations. The following guidance may be considered for that purpose:

a) the mounting method for the EFB should allow easy access to the EFB controls and a clear unobstructed view of the EFB display by the pilot when strapped in the normal seated position. It should be located such that the effects of glare and/or reflections are minimized. This may be accomplished by providing some adjustment by the flight crew to compensate for glare and reflections;

b) it should be confirmed that the intended EFB hardware in its mounting device does not obstruct visual or physical access to aircraft displays, controls, or external vision and that its location does not impede crew ingress, egress and emergency egress paths; and

c) there should be no mechanical interference between the EFB in its mounting device and any of the flight controls in terms of full and free movement, under all operating conditions and no interference with buckles, oxygen hoses, etc.

1.2.2 Data connectivity

The capability of connecting the EFB to certified aircraft systems has to be covered by an airworthiness approval.

Certified aircraft systems should be protected from adverse effects of EFB system failures by using a certified AID. An AID may be implemented as a dedicated device, e.g. as defined in ARINC 759, or it may be implemented in non-dedicated devices, such as an EFB docking station, a network file server or other avionics equipment.

1.2.3 Power to the EFB

Installed power provisions should comply with the applicable airworthiness regulations. Connection of the EFB to a non- essential, or to the least critical power bus, is recommended, so failure or malfunction of the EFB, or power supply, will not affect safe operation of aircraft critical or essential systems.

1.3 HARDWARE CONSIDERATIONS FOR PORTABLE EFBs

Portable EFBs can be used as either hand-held equipment or mounted in a fixed or movable mount attached to the aircraft structure or temporarily secured (e.g. kneeboard, suction cup).

1.3.1 Physical characteristics

The size and practicality of the EFB should be evaluated as some devices may prove to be cumbersome for normal use on a flight deck.

1.3.2 Readability

The EFB data should be legible under the full range of lighting conditions expected on the flight deck, including direct sunlight.

1.3.3 Environmental

The EFB has to be operable within the foreseeable cockpit operating conditions including foreseeable high/low temperatures and after rapid depressurization if the EFB is intended for use in such an event.

1.3.4 Basic non-interference testing

As previously noted, portable EFBs are considered to be PEDs. As such, any reference to PEDs in this section is also applicable to portable EFBs.

In order to operate a portable EFB during flight, the user/operator is responsible for ensuring that the EFB will not interfere in any way with the operation of aircraft equipment. The following methods are means to test portable EFBs that are to remain powered (including being in standby mode) throughout the flight, in order to ensure that they will not electromagnetically interfere with the operation of aircraft equipment.

Method 1

Step 1 is an electromagnetic interference (EMI) test using RTCA/DO-160, Section 21, Category M. An EFB vendor or other source can conduct this test for an EFB user/operator. An evaluation of the results of the RTCA/DO-160 EMI test can be used to determine if an adequate margin exists between the EMI emitted by the EFB and the interference susceptibility threshold of aircraft equipment. If this step determines that adequate margins exist for all interference, then the test is complete. However, if this step identifies inadequate margins for interference, then step 2 testing must be conducted.

Step 2 testing is a complete test in each aircraft using standard industry practices. This should be done to the extent normally considered acceptable for non-interference testing of a portable EFB in an aircraft for all phases of flight. Credit may be given to other aircraft of the same make and model equipped with the same avionics as the one tested.

Method 2

As an alternative, Step 2 of Method 1 can be used directly in order to determine non-interference of the EFB.

1.3.5 Additional testing for transmitting portable EFBs

In order to activate the transmitting functions of a portable EFB during flight in conditions other than those that may be already certified at aircraft level (e.g. tolerance to specific transmitting PED models) and hence documented in the aircraft flight manual or equivalent, the user/operator must ensure that the device will not interfere with the operation of the aircraft equipment in any way. The following is a method to test transmitting portable EFBs that are to remain powered (including being in standby mode) during flight.

This test consists of two separate test requirements:

Test Requirement 1. Each model of the device should have an assessment of potential electro-magnetic interferences (EMI) based on a representative sample of its frequency and power output. This EMI assessment should follow a protocol such as the applicable processes set forth in RTCA/DO-294, *Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDs) on Aircraft*. This frequency assessment must confirm that no interference of aircraft equipment will occur as a result of intentional transmissions from these devices.

Test Requirement 2. Once an EMI assessment has determined that there will be no interference from the EFB's intentional transmissions (Test Requirement 1), and basic non-interference testing has been conducted with the device not deliberately transmitting (see Chapter 3, 3.4), non-interference testing should be conducted with the transmit function being operative. The position of the transmitting device is critical to non-interference testing; hence, locations of the EFB and of the transmitter (if applicable) should be clearly defined and adhered to.

1.3.6 Power supply, connection and source

The operator should ensure that power to the EFB, either by battery and/or externally supplied power, is available to the extent required for the intended operation.

The power source needs to be suitable for the device. The power source may be a dedicated power source or a general purpose source already fitted.

Means to turn off the power source, other than a circuit breaker, should be reachable by the pilot when strapped in the normal seated position (e g. access to unplug the EFB or a separate hardware or software switch clearly labelled for the power source).

1.3.7 Batteries

The operator should ensure that the batteries are compliant with the applicable Standards for use in an aircraft.

The operator should consider introducing procedures to handle thermal runaways or similar battery malfunctions potentially caused by EFB batteries (e.g. lithium-based batteries). At least the following issues should be addressed:

a. risk of leakage;

b. safe storage of spares including the potential for short circuit; and

c. hazards due to on-board continuous charging of the device, including battery overheat.

Cabling

The operator needs to ensure that any cabling attached to the EFB, whether in the dedicated mounting or when hand- held, does not present an operational or safety hazard.

Temperature rise

Operating the proposed EFB device may generate heat. The placement of the EFB should allow sufficient airflow around the unit, if required.

Data connectivity between EFBs

If two or more EFBs on the flight deck are connected to each other, then the operator should demonstrate that this connection does not negatively affect otherwise independent EFB platforms.

Data connectivity to aircraft systems

See paragraph 1.2.2.

External connectivity

Some EFBs may have the provision for external ports other than power or data connectivity with aircraft systems (e.g. an antenna or a data connection to the operator ground network). External connectivity leading to a change to the aircraft type design should require an airworthiness approval. The extent of this information is dependent on the complexity of the interface to the aircraft systems.

Stowage

All hand-held EFBs not secured on the flight crew (e.g. kneeboard) or into an existing aircraft part (e.g. suction cups) need to be stowed during critical phases of flight to ensure the safety of the occupants of the flight deck. Stowage needs to be configured such that the EFB can be easily stowed securely but remain readily accessible in-flight. The method of stowage should not cause any hazard during aircraft operations.

Viewable stowage

A portable EFB not mounted in a mounting device may be used during all phases of flight provided that it is secured on the flight crew or into an existing aircraft part with the intended function to hold acceptable light mass portable devices viewable to the pilot at her/his required duty station. This viewable stowage device is not necessarily part of the certified aircraft configuration. Its location should be documented in the EFB policy and procedures manual.

Some types of viewable stowage securing means may have characteristics that degrade appreciably with aging or due to various environmental factors. In that case, it should be ensured that the stowage characteristics remain within acceptable limits for the proposed operations. Securing means based on vacuum (e.g. suction cups) have a holding capacity that decreases with pressure. It should be demonstrated that they will still perform their intended function at operating cabin altitudes.

In addition, it should be demonstrated that if the EFB moves or is separated from its stowage, or if the viewable stowage is unsecured from the aircraft (as a result of turbulence, manoeuvring, or other action), it will not interfere with flight controls, damage flight deck equipment, or injure flight crew members.

CHAPTER 2

2.0 HUMAN FACTORS

The operator should carry out an assessment of the human-machine interface and aspects governing crew coordination when using the EFB. Whenever possible, the EFB user interface philosophy should be consistent (but not necessarily identical) with the flight deck design philosophy. The review of the complete system should include, but is not limited to:

a. general considerations including workload, usability, integration of the EFB into the flight deck, display and lighting issues, system shutdown, and system failures;

b. physical placement issues, including stowage area, use of unsecured EFBs, design and placement of mounting devices;

c. considerations for interference with anthropometric constraints, cockpit ventilation, and speaker sound;

d. training and procedures considerations, including training on using EFB applications, the EFB policy and procedures manual, fidelity of the EFB training devices, and mechanisms for gathering user feedback on EFB use;

e. hardware considerations — refer to Chapter 1; and

f. software considerations — refer to Chapter 6.

CHAPTER 3

3.0 CREW OPERATING PROCEDURES

3.1 GENERAL

The operator should have procedures for using the EFB in conjunction with the other flight deck equipment.

If an EFB generates information similar to that generated by existing flight deck systems, procedures should clearly identify:

a. which information source will be primary;

b. which source will be used as secondary information;

c. under what conditions to use the secondary source; and

d. what actions to take when information provided by an EFB does not agree with that from other flight deck sources, or, if more than one EFB is used, when one EFB disagrees with another.

If normal operational procedures require an EFB for each flight deck crew member, the set-up should comply with the definition of independent EFB platforms.

Operators should include the requirements for EFB availability in the operations manual and/or as part of the minimum equipment list.

3.2 REVISIONS AND UPDATES

The operator should have a procedure in place to allow flight crews to confirm the revision number and/or date of EFB application software including, where applicable, database versions (e.g. update to the latest aeronautical charts).

Flight crews should not, however, have to confirm the revision dates for databases that would not, in case of outdated data, adversely affect flight operations. Procedures should specify what actions to take if the software applications or databases loaded on the EFB are out of date.

3.3 WORKLOAD AND CREW COORDINATION

In general, using an EFB should not increase the crew's workload during critical phases of flight. For other flight phases, crew operating procedures should be designed to mitigate and/or control additional workload created by using an EFB.

Workload should be distributed between flight crew members to ensure ease of use and continued monitoring of other flight crew functions and aircraft equipment. The procedures should include specification of the phases of flight at which the flight crew may not use the EFB, if applicable.

3.4 REPORTING

A reporting system for EFB failures should be established. Procedures should be in place to inform maintenance and flight crews about a fault or failure of the EFB, including actions to isolate it until corrective action is taken.

CHAPTER 4

4.0 FLIGHT CREW TRAINING

The use of the EFB should be conditional on appropriate training. Training should be in accordance with the operator's SOP (including abnormal procedures) and should include:

a. an overview of the system architecture;

b. preflight checks of the system;

c. limitations of the system;

d. the use of each operational software application;

e. restrictions on the use of the system, including when some or all of the EFB functions are not available;

f. the conditions (including phases of flight) under which the EFB may not be used;

g. procedures for cross-checking data entry and computed information;

h. human performance considerations on the use of the EFB;

i. additional training for new applications, new features of current applications, or changes to the hardware configuration;

j. recurrent training and proficiency checks; and

k. any area of special emphasis raised during the EFB evaluation with the CAA.

CHAPTER 5

5.0 EFB RISK ASSESSMENT

5.1 GENERAL

The EFB risk assessment is a process that should be performed to assess the risks associated with the use of each EFB function and should allow the operator to keep the risks to an acceptable level by defining the appropriate mitigation means.

This risk assessment should be performed before the beginning of the approval process (if applicable) and its results should be reviewed on a periodic basis.

The guidance on safety risk assessment is contained in the *Safety Management Manual (SMM)* (Doc 9859).

5.2 EFB FAILURES AND MITIGATION MEANS

Based on the outcome of the EFB risk assessment, the operator should determine the need for software architectural features, personnel, procedures, and/or equipment that will eliminate, reduce, or control risks associated with an identified failure in a system.

Mitigation against EFB failure or impairment may be accomplished by one or a combination of:

a. system design;

b. separate and backup power sources for the EFB;

c. electronic fallback solutions to the last known, stable configuration (e.g. before an update);

d. redundant EFB applications hosted on independent EFB platforms;

e. paper products carried by selected crew members;

f. complete set of sealed paper backups in the flight deck; and/or

g. procedural means.

CHAPTER 6

6.0 EFB FUNCTIONS

6.1 GENERAL

Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes* and Part III — *International Operations — Helicopters*, Section II require that the State of the Operator specifically approve the operational use of EFB functions to be used for the safe operation of aircraft.

Annex 6, Part II — *International General Aviation — Aeroplanes* and Annex 6, Part III, Section III require that the State of Registry establish criteria for the operational use of EFB functions to be used for the safe operation of aircraft.

EFB functions to be used for the safe operation of aircraft are considered to be those whose failure, malfunction or misuse would have an adverse effect on the safety of flight operations (e.g. increase in-flight crew workload during critical phases of flight, reduction in functional capabilities or safety margins).

Those functions should be recorded in the operations manual and linked to the operations specifications as proposed in Appendix C (for commercial air transport), (see 9.6).

The applications below may be considered examples of applications providing such functions, depending on their use, associated procedures, and failure mitigation means:

a. a document browser displaying information required to be carried by regulations (subject to approval, where required);

b. electronic aeronautical chart applications;

c. airport moving map display (AMMD) applications, not used as a primary means of navigation on the ground and used in conjunction with other materials and procedures;

d. cabin-mounted video and aircraft exterior surveillance camera displays;

e. an aircraft performance calculation application to provide take-off, en-route, approach, landing and missed approach performance calculations; and

f. a mass and balance calculation application.

These applications require special attention during their evaluation, as described in Appendix A.

On the contrary, the following features are not EFB functions and, unless certified as avionics functions, should not be hosted on an EFB:

a. displaying information which may be tactically used by the flight crew members to check, control, or deduce the aircraft position or trajectory, either to follow the intended navigation route or to avoid adverse meteorological conditions, obstacles or other traffic, in-flight or on ground;

b. displaying information which may be directly used by the flight crew to assess the real-time status of aircraft critical and essential systems, as a replacement for existing installed avionics, and/or to manage aircraft critical and essential systems following failure;

   (i) communicating with air traffic control;

   (ii) sending data to aircraft systems not certified for this intended purpose; and

   (iii) if the CAA determines that the function requires airworthiness certification.

c. The display of own-ship position, in-flight, for strategic use is not universally accepted by State authorities and not specifically covered in this manual. If an operator elects to implement the display of own-ship position, in-flight, on an EFB application, the following risks should be addressed and properly mitigated:

   (i) use of hazardously misleading information (in particular in case of erroneous position or frozen display);

   (ii) misuse of the information for short-term piloting, e.g. for track monitoring purposes (see 6.1.6, a));

   (iii) excessive fixation on EFB information and excessive head-in time; and

   (iv) conflicting information with certified aircraft systems.

d. Possible effects of improperly mitigated risks are increase in workload and decrease in situation awareness. In some cases, crews might unknowingly build an over-reliance on this uncertified, yet compelling information.

6.2 CONSIDERATIONS FOR ALL EFB APPLICATIONS

6.2.1 Software HMI

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

Software considerations, including ease of access to common functions, consistency of symbols, terms and abbreviations, legibility of text, system responsiveness, methods of interaction, use of colour, display of system status, error messages, management of multiple applications, off-screen text/content and use of active regions should be addressed.

Use of colours and messages. The colour "red" should be used only to indicate a warning level condition. "Amber" should be used to indicate a caution level condition. Any other colour may be used for items other than warnings or cautions, providing that the colours used differ sufficiently from the colours prescribed to avoid possible confusion. EFB messages and reminders should be integrated with (or compatible with) presentation of other flight deck system alerts. EFB aural messages should be inhibited during critical phases of flight. If, however, there is a regulatory requirement that is in conflict with the recommendation above, those should have precedence.

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 an indication of its status available to the user upon request. It may be desirable to prioritize these EFB status and fault messages.

Data entry and error messages. If user-entered data are 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 are expected.

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.

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 off-screen content is not indicated. This should be evaluated based on the application and intended operational function.

Software developers and operators are encouraged to evaluate the usability of an existing HMI before developing a new HMI themselves. It is also recommended to review the HMI after some time of operation in the everyday environment for unforeseeable common human errors with special regard to the specific-use case of the operator, which require changes or enhancement of the given design.

6.2.2 Electronic signatures

State regulations may require a signature to signify acceptance or to confirm the authority.

In order to be accepted as an equivalent to a handwritten signature, electronic signatures used in EFB applications need, as a minimum, to fulfil the same objectives and should, as a minimum, assure the same degree of security as the handwritten or any other form of signature it intends to replace.

Note.— Guidance on electronic signatures is contained in the Safety Management Manual (SMM) *(Doc 9859).*

6.3 CONSIDERATIONS FOR EFB APPLICATIONS TO BE USED FOR THE SAFE OPERATION OF AIRCRAFT

6.3.1 EFB management

The operator should have an EFB management system in place. Complex EFB systems may require more than one individual to support the EFB management system. However, at least one person (e.g. dedicated EFB manager, OPS director) should possess an overview of the complete EFB system, including the distribution of responsibilities within the operator's management structure.

EFB management is the key link between the operator and the EFB system and software suppliers.

EFB management is responsible for hardware and software configuration management, and for ensuring, in particular, that no unauthorized software is installed. EFB management is also responsible for ensuring that only a valid version of the application software and current data packages are installed on the EFB system. For some software applications there should be a means for operators to carry out their own check of data content prior to load and/or release for operational use.

The EFB management system should ensure that software applications supporting function(s) not directly related to operations conducted by the flight crew on the aircraft (e.g. web browser, email client, picture management) do not adversely impact the operation of the EFB.

Each person involved in EFB management should receive appropriate training in their role and should have a good working knowledge of the proposed system hardware, operating system and relevant software applications as well as knowledge about flight operations.

EFB management should establish procedures to ensure that no unauthorized changes take place to EFB applications. An EFB policy and procedures manual may be part of the operator's operations manual (see Appendix D).

Procedures should be established for the maintenance of the EFB.

EFB management should be responsible for the procedures and systems, documented in the EFB policy and procedures manual that maintain EFB security and integrity. The required level of EFB security depends on the criticality of the used applications.

Any new or modified EFB application requires a reassessment for proper functioning and whether any additional training or procedures are necessary.

6.3.2 Quality Assurance

The operator should ensure that the software developer has a quality assurance process in place. The software development and verification processes should be included and documented in the quality assurance process.

CHAPTER 7

7.0 OPERATIONAL EVALUATION PROCESS

The operational evaluation process is designed to lead to the issue of a specific approval, where such is required, and consists of the following courses of actions. Elements of this process are to be understood as guidelines for CAAs and operators and may also be used in instances where specific approval is not required.

Note.— This process is applicable to commercial air transport only.

7.1 DEFINITION OF THE SCOPE

The scope of the operational evaluation plan will depend upon the applicant's experience with EFBs. Considerations should include whether the operator has:

a. no EFB experience, thus requiring a "new application and approval process"; or

b. initiated the process of establishing an EFB programme; or

c. an existing approved EFB programme established.

An operator implementing EFB functions may choose to start a paperless flight deck operation without paper backup or a combination of solutions with limited on-board paper backup. The operator may also choose to keep the paper backup as a cross-check against the EFB information and as a means of mitigation against failure, when transitioning from paper to electronic format.

7.2 INITIAL DISCUSSION WITH THE CAA (PHASE 1)

During this phase, the regulator and the operator reach a common understanding of what needs to be evaluated, the role of the regulator, the applicable requirements, whether trials should take place and when, how they must be conducted and documented, and what documents and actions the operator is responsible for during each phase of the approval process.

7.3 APPLICATION (PHASE 2)

Phase 2 begins when the operator submits a formal compliance plan to the CAA for evaluation. The plan is reviewed for completeness and compliance to the regulations and the CAA may coordinate with other inspectors and regulatory offices as necessary. Once the CAA is satisfied with the submitted plan, the operator follows that plan to produce a complete EFB programme. The operator must clarify the intent of the operation (with or without paper backup or a combination of paperless and paper). The applicant will typically submit information in the application package, such as:

a. EFB operational suitability report (if applicable);

b. EFB hardware and application specifications;

c. EFB operator procedures/manual revisions;

d. EFB training programme;

e. EFB evaluation report; and

f. EFB risk assessment.

7.4 CAA REVIEW (PHASE 3)

The CAA should use a checklist (see Appendix B) to conduct a review of the application submitted by an operator.

Where an operator seeks to start operations with a new EFB system, the CAA should participate in the simulator evaluation or flight evaluation of an EFB. Additional simulator or flight evaluations are not required for adding a new EFB to an existing approval unless there is a substantial change in EFB-intended functions. When a new aircraft is added to an existing EFB approval, the suitability of the EFB for that aircraft must be addressed. The CAA should examine the technical content and quality of the proposed EFB programme and other supporting documents and procedures.

7.5 OPERATIONAL EVALUATION (PHASE 4)

The operator should conduct an operational evaluation that verifies whether the above elements have been satisfied. The operator should notify its CAA of its intention to conduct an operational evaluation by sending a plan and keep a receipt of this notification in the aircraft during the test period.

During this validation phase, operators transitioning from paper to EFB should maintain paper backup for all electronic information. The validation phase begins when the operator formally begins use of the EFB combined with paper backup for an established period of time. Appendix B may be used for data collection during the validation phase.

Operators starting EFB operations without paper backup should have adequate mitigations means in place to access the information in case of EFB failures.

Final considerations by the CAA:

a. *Unacceptable validation results.* If the CAA finds the proposed EFB reliability and/or function to be unacceptable, the CAA should contact the operator for corrective action. EFB deficiencies should be corrected and the EFB function revalidated prior to approval being issued.

b. *Acceptable validation results.* If the CAA finds the proposed EFB reliability and/or function to be acceptable based on validation data, then the specific approval may be issued.

7.6 ISSUANCE OF EFB OPERATIONS SPECIFICATIONS AND APPROVAL (PHASE 5)

The CAA granting a specific EFB approval to the operator should update the operations specifications with an EFB entry. The operations specifications will reference the location in the operations manual where more details of the approved EFB applications can be found (see Appendix C).

CHAPTER 8

8.0 EFB USE IN GENERAL AVIATION OPERATIONS WITH HELICOPTERS OR OTHER THAN LARGE OR TURBOJET AEROPLANES

8.1 EQUIPMENT/HARDWARE CONSIDERATIONS

Operators involved in general aviation with helicopters or other than large or turbojet aeroplanes, should consider the following provisions before using an EFB.

The operator should follow the provisions of 1.3 of this manual when using a portable EFB.

8.2 PILOT OPERATING PROCEDURES

To ensure that adequate guidance is available for use of the EFB applications, the user guide established by the software developer should be available to the pilot.

8.3 PILOT TRAINING

The pilot should be familiar with EFB use before using it in-flight. Changes to EFB hardware or software may warrant additional familiarization.

8.4 EFB RISK ASSESSMENT

For general aviation operations, hazard assessment in the traditional sense is not practical; therefore the following mitigations are presented to address risks associated with EFB use. Before each flight, the pilot should conduct the following checks to ensure the continued safe operation of the EFB during the flight:

a. general check of the EFB operation by switching it ON and checking that the applications intended to be used in-flight are operative;

b. for applications required throughout the flight, check battery or other power sources to ensure the availability of the EFB during taxi and flight operations to include diversions and reasonable delays;

c. check for currency of EFB databases (effective dates), (e.g. aeronautical charts, performance calculation, and weight and balance applications); and

d. check that an appropriate back-up is available when using an application displaying information or data required to be on-board.

8.5 EFB FUNCTIONS

If EFB applications provide functions, displaying information related to the aircraft position in-flight, navigation, terrain or traffic surroundings, or altitude, the pilot should be aware of the potential misleading or erroneous information displayed and should only use these functions as an advisory means.

When using an aeronautical chart, performance, mass and balance, in-flight weather application or an airport moving map display (AMMD), the following considerations should be taken into account by the pilot:

Aeronautical chart application: The aeronautical charts that are depicted should contain the information necessary, in appropriate form, to conduct the flight safely. Consideration should be given to the size and resolution of the display to ensure legibility.

Performance calculation and mass and balance (M&B) application: Prior to the first use of a performance or M&B application, and following any update of the database supporting the application, the operator should obtain assurance that the output of the application corresponds with the data derived from the AFM (or other appropriate sources).

Airport moving map display application: An AMMD application should not be used as a primary means of navigation for taxi; outside references remain primary.

In-flight weather application: The displayed meteorological information may be forecast and/or observed, and may be updated on the ground and/or in-flight. It should be based on data from providers approved by the meteorological authority concerned, or other sources approved by the operator. Consideration should be given to the latency of meteorological information and the hazards associated with utilization of latent information. Pilots should only use in-flight weather applications for broad strategic avoidance of adverse meteorological conditions.

8.6 EVALUATION PROCESS

As stated in Chapter 7, an evaluation process is not required, but it is nevertheless recommended that pilots and/or the operator/owner undergo an evaluation period to ensure that mitigations to risk, including EFB failures, EFB misuse and other EFB malfunctions are addressed. During this period, the pilot or owner/operator should validate that the EFB is as available and reliable as the paper-based system being replaced, if applicable.

APPENDIX A - GUIDANCE FOR EFB SOFTWARE APPLICATIONS

Preamble

The purpose of this appendix is to provide information on best practices and general guidance for the development of commonly used EFB software applications. The specific examples used are not intended to preclude alternate methods which may accomplish similar objectives. In addition, operators who have been granted a specific approval for particular EFB software applications may wish to consider adopting the methods discussed within this attachment.

Manufacturers, operators or vendors should carefully consider their particular operational needs when developing EFB software applications in an effort to maintain the highest safety and reliability standards for their specific-use case.

TAKE-OFF AND LANDING PERFORMANCE (TALP) AND MASS AND BALANCE (M&B) APPLICATIONS

1.1 Introduction

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.

Appropriate civil aviation authorities should consider the application architecture, HMI, documented testing results, and the operator's EFB procedures and training before approving the operational use of EFB, TALP and M&B applications.

1.2 Take-off and landing performance applications architecture

TALP applications are usually separated into different layers:

a. human-machine interface (HMI);

b. calculation module;

c. aircraft-specific information; and

d. airport, runway, obstacle database (AODB).

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.

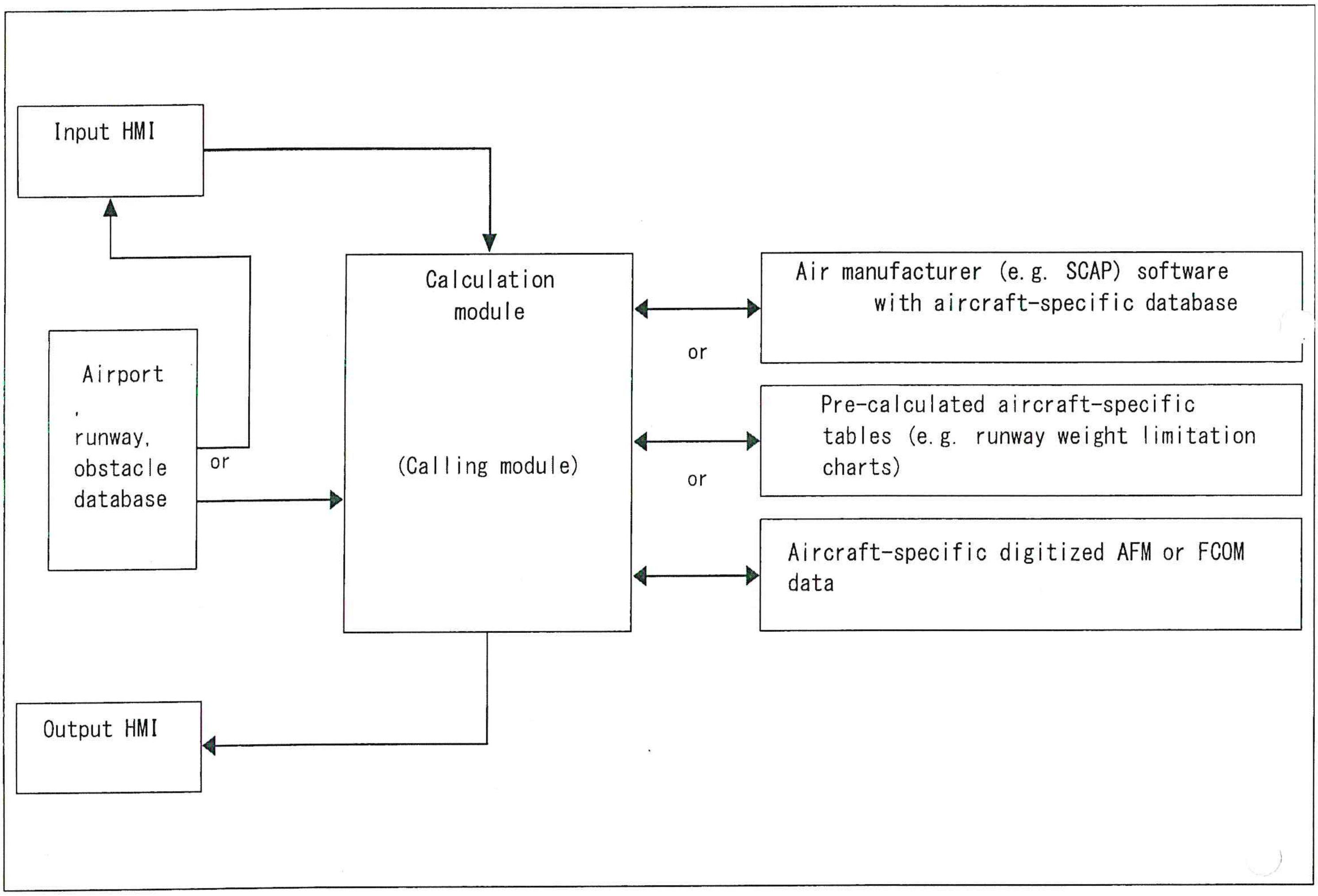

Figure A-1. Typical architecture of a TALP application

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.

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

TALP source data generally is 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.

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) Standardised Computerised Aircraft Performance (SCAP) specification. The IATA SCAP specification provides a standardized means for manufacturers, operators and third parties to exchange aircraft performance data.

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"). To obtain the results, the calculation module assembles the inputs from the HMI and other sources, and might call the SCAP software several times. Thus, the expression "calling module" has become widespread in the industry.

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

In some cases, where manufacturer software and data are not available, paper AFM or FCOM charts may be digitized by third parties that develop the data for their own products.

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

SCAP modules or the equivalent delivered by the manufacturer;

the operator can build its own digitized aircraft performance data, based on the data published in the flight manual; and

data based on pre-calculated take-off or landing performance tables.

Airport, runway, obstacle database (AODB). Take-off 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 TAKE-OFF AND LANDING PERFORMANCE, MASS AND BALANCE APPLICATIONS AND HUMAN-MACHINE INTERFACE (HMI)

Operators and authorities should be aware that 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 are examples of design guidelines that are supplemental to the software HMI considerations from Chapter 6:

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 used in the manuals and should match the 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 must 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 are 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 clearly be 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), in accordance with general HMI considerations (see Chapter 6);

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 with the input parameters used for 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 TAKE-OFF AND LANDING PERFORMANCE AND MASS AND BALANCE APPLICATIONS TESTING

Accurate TALP and M&B calculations are essential to safe aircraft operation. EFB applications can be effective tools used to make these calculations. Authorities and operators should be aware of the importance of thoroughly testing EFB applications that use mathematical algorithms or calculation modules before they are approved for operational use.

Applications designed to perform TALP and M&B calculations must use data derived from the AFM or other appropriate sources, as accepted by the operator's CAA.

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

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.

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.

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).

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).

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).

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 CAA.

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.

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

Tests should be acceptable to the operator's CAA.

User interface tests. Tests designed to verify that an application's user interface is acceptable.

Test cases should be defined to demonstrate that:

a) the HMI requirements are complied with. (See section 1.3.1 in Appendix A.);

b) the application has a reasonable system response when incorrect values are inadvertently entered;

c) the application provides easily comprehended results or error messages/instructions if incorrect input values (e.g. outside envelope, wrong combination of inputs) are entered; and

d) 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.

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.

a. Test cases should be defined that demonstrate that the application:

b. functions correctly on the EFB platform;

c. does not adversely impact other EFB applications or aircraft systems or vice versa; and

d. correctly interfaces with other applications when applicable (e.g. take-off performance using results from M&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

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 (e.g. flight dispatchers, flight operating officers, operating personnel) that may have roles defined in the use of the applications.

TALP and M&B data should be independently calculated and cross-checked by both pilots. When a dispatch system described in 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*

Procedures should ensure that 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*

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*

Training should emphasize the importance of executing all TALP and M&B performance calculations in accordance with SOP to assure fully independent and cross-checked 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.

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 (ZFM) as take-off mass (TOM) or transposed digits.

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

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

1.5.5 Management of performance take-off and landing performance and mass and balance EFB applications

Within the operator's organization, the responsibilities between the TALP and M&B management and the EFB management should be clear and well-documented. An operator should utilize a designated person/group that is sufficiently trained to provide support for the performance tools. This person/group must have comprehensive knowledge of current regulations, TALP and M&B, and TALP and M&B software (e.g. SCAP modules) used on the EFB.

1.6 ELECTRONIC CHARTING APPLICATION

1.6.1 Description

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

Considerations:

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) 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.

1.7 TAXI AID CAMERA SYSTEM (TACS)

1.7.1 Description

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

Considerations:

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). 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.

1.8 AIRPORT MOVING MAP DISPLAY (AMMD)

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

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.

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, i.e. inadvertently entering a runway.

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 Annex 6, Part I, 7.5 — *Electronic navigation 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.

1.9 FLIGHT CREW TRAINING

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

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

5.0 ELECTRONIC CHECKLIST APPLICATION

5.1 SCOPE

An electronic checklist (ECL) is an EFB application which displays checklists to the flight crew by means of an EFB.

This guidance applies to:

a) an ECL displaying pre-composed information or featuring a specific HMI to display the information in an optimized way to the flight crew;

b) an ECL with or without capability to interact with the pilot to record the completion of the actions and checklists;

c) an 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 manual.); and

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

e) Other ECL functionalities, such as those identified in the list below, may be present in which case the operator's CAA is responsible for the establishment of the applicable basis for compliance:

f) 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; and

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

5.2 HMI DESIGN AND HUMAN FACTORS CONSIDERATIONS

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

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 an 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; and

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

j) Additional HMI and human factor considerations for ECL with capability to interact with the pilot to record the completion of the actions and checklists:

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

l) ECL should display the completion status of action items within a checklist;

m) 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; and

n) if needed, it should be possible to uncheck an action item in a checklist.

5.3 FLIGHT CREW PROCEDURES

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

Flight crew procedures should be established to:

a) ensure that the flight crew verifies the validity of the ECL database before use; and

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).

5.4 ADMINISTRATION

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.

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).

5.5 FLIGHT CREW TRAINING AND DOCUMENTATION

5.5.1 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

In the context of this manual, in-flight weather (IFW) is an electronic flight bag (EFB) function enabling the crew to access meteorological information.

6.2 INTENDED USE AND LIMITATIONS

The introduction of IFW is supplemental to the information required by Annex 3 — *Meteorological Service for International Air Navigation*. It would contribute to increased situational awareness and support the flight crew when making strategic decisions.

The IFW application could be used to access both information required to be on board (e.g. world area forecast system (WAFS) data) and supplemental weather information.

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

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).

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

Meteorological information in IFW applications may be displayed, for example, as an overlay on aeronautical charts and geographical maps or may be a stand-alone weather depiction (e.g. radar images, satellite images).

Note.— This manual will not supersede the regulatory material contained in Annex 3.

6.3 METEOROLOGICAL INFORMATION CONSIDERATIONS

Meteorological information can be forecast and/or observed, and can be updated on the ground and/or in- flight. It should be based on data from providers approved by the meteorological authority concerned or other sources approved by the operator.

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

6.4 DISPLAY CONSIDERATIONS

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.

Presentation should include:

a) type of information contained in the meteorological information (i.e. observed or forecast);

b) currency or age and validity time of the meteorological information;

c) information necessary for interpreting the meteorological information (e.g. legend); and

d) a 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.

If meteorological information is overlaid 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.

Meteorological information may require reformatting for cockpit use, for example, to 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.

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.

It is recommended that the IFW is able to display the meteorological information in relation to the route or operational flight plan, in order to ease interpretation of forecast information.

6.5 RAINING AND PROCEDURES

The operator is required to specify standard operating procedures (SOPs) specifying the use of IFW information.

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 meteorological information and the hazards associated with utilization of old information;

c) that IFW information beyond Annex 3 specification, is supplementary to the required information;

d) use of the application;

e) different types of displayed information (e.g. forecast or observed);

f) symbology (e.g. symbols, colors);

g) interpretation of meteorological information;

h) identifying failures (e.g. incomplete uplinks, datalink failures, missing information);

i) avoiding fixation; and

j) managing workload.

6.6 NOTE

Consideration should be given to the speed of technological development. The authority providing or arranging for the provision of meteorological service for international air navigation on behalf of a Contracting State (meteorological authority) should collaboratively work with the stakeholders to assess and, if requirements are met (e.g. actuality, latency, accuracy), enable new service implementation.

Whenever possible, future comparable information display functions, e.g. volcanic ash, solar radiation, should consider this guidance unless specific guidance is available.

APPENDIX B

1.0 SPECIFIC APPROVAL CHECKLIST

1.1 INTRODUCTION

The checklists below constitute an example of what may be used during Phase 3 (CAA review) of the EFB operational evaluation process.

Checklist items can be customized to the specific EFB and applications being evaluated.

Checklist items are designed so that some questions may be not applicable (check "N/A"). Questions answered as "No" are meant to allow identifying deficiencies that should be corrected and revalidated prior to approval being issued.

1.2 SPECIFIC APPROVAL CHECKLIST

CL; O-GEN024

Part I AIR WORTHINESS PROCESS	Assessment			
HARDWARE	**YES**	**NO**	**N/C**	**NA**
Have the installed EFB resources been certified by a CAA to accepted aviation standards either during the certification of the aircraft, service bulletin by the original equipment manufacturer, or by a third-party STC?				
Has the operator assessed the physical use of the device on the flight deck to include safe stowage, crashworthiness (mounting devices and EFBs, if installed), safety and use under normal environmental conditions including turbulence?				
Will the display be readable in all the ambient lighting conditions, both day and night, encountered on the flight deck?				
Has the operator demonstrated that the EFB will not electromagnetically interfere with the operation of aircraft equipment?				
Has the EFB been tested to confirm operation in the anticipated environmental conditions (e.g. temperature range, low humidity, altitude)?				
Have procedures been developed to establish the level of battery capacity degradation during the life of the EFB?				
Is the capability of connecting the EFB to certified aircraft systems covered by an airworthiness approval?				

Item	Assessment			
	YES	NO	N/C	NA
When using the transmitting functions of a portable EFB during flight, has the operator ensured that the device does not electromagnetically interfere with the operation of the aircraft equipment in any way?				
If two or more EFBs on the flight deck are connected to each other, has the operator demonstrated that this connection does not negatively affect otherwise independent EFB platforms? Can the brightness or contrast of the EFB display be easily adjusted by the flight crew for various lighting conditions?				
INSTALLATION				
Mounting				
Has the installation of the mounting device been approved in accordance with the appropriate airworthiness regulations?				
Is it evident that there are no mechanical interference issues between the EFB in its mounting device and any of the flight controls in terms of full and free movement, under all operating conditions and no interference with other equipment such as buckles, oxygen hoses, etc.?				
Has it been confirmed that the mounted EFB location does not impede crew ingress, egress and emergency egress path?				
Is it evident that the mounted EFB does not obstruct visual or physical access to aircraft displays or controls?				
Does the mounted EFB location minimize the effects of glare and/or reflections?				
Does the mounting method for the EFB allow easy access to the EFB controls and a clear unobstructed view of the EFB display?				
Is the EFB mounting easily adjustable by flight crew to compensate for glare and reflections?				
Does the placement of the EFB allow sufficient airflow around the unit, if required?				

Item	Assessment			
	YES	NO	N/C	NA
Note.— This part should be completed multiple times to account for the different software applications being considered.				
SOFTWARE				
Software application:_______________(fill in name of software application)				
Is the application considered an EFB function (see Chapter 6)?				
Has the software application been evaluated to confirm that the information being provided to the pilot is a true and accurate representation of the documents or charts being replaced?				
Has the software application been evaluated to confirm that the computational solution(s) being provided to the pilot is a true and accurate solution (e.g. performance, and mass and balance (M&B))?				
Does the software application have adequate security measures to ensure data integrity (e.g. preventing unauthorized manipulation)?				
Does the EFB system provide, in general, a consistent and intuitive user interface, within and across the various hosted applications?				
Has the EFB software been evaluated to consider HMI and workload aspects?				
Does the software application follow Human Factors guidance?				
Can the flight crew easily determine the validity and currency of the software application and databases installed on the EFB, if required?				
Power connection / batteries				
Is there a means other than a circuit-breaker to turn off the power source (e.g. can the pilot easily remove the plug from the installed outlet)?				
Is the power source suitable for the device?				
Have guidance/procedures been provided for battery failure or malfunction?				
Is power to the EFB, either by battery and/or supplied power, available to the extent required for the intended operation?				
Has the operator ensured that the batteries are compliant to acceptable standards?				

Cabling				
Has the operator ensured that any cabling attached to the EFB, whether in the dedicated mounting or when hand-held does not present an operational or safety hazard (e.g. it does not interfere with flight controls movement, egress, oxygen mask deployment)?				

Item	**Assessment**			
	YES	**NO**	**N/C**	**NA**
Stowage				
If there is no mounting device available, can the EFB be easily stowed securely and readily accessible in-flight?				
Is it evident that stowage does not cause any hazard during aircraft operations?				
Viewable stowage				
Has the operator documented the location of its viewable stowage?				
Has the operator ensured that the stowage characteristics remain within acceptable limits for the proposed operations?				
Has the operator demonstrated that if the EFB moves or is separated from its stowage, or if the viewable stowage is unsecured from the aircraft (as a result of turbulence, manoeuvring, or other action), it will not interfere with flight controls, damage flight deck equipment, or injure flight crew members?				

Hardware management procedures				
Are there documented procedures for the control of EFB hardware configuration?				
Do the procedures include maintenance of EFB equipment?				
Software Management Procedures				
Are there documented procedures for the configuration control of loaded software and software access rights to the EFB?				
Are there adequate controls to prevent corruption of operating systems, software, and databases?				
Are there adequate security measures to prevent system degradation, malware and unauthorized access?				
Are procedures defined to track database expiration/updates?				
Are there documented procedures for the management of data integrity?				
If the hardware is assigned to the flight crew, does a policy on private use exist?				

Part 2 FLIGHT OPERATIONS PROCESS				
MANAGEMENT				
EFB management				
Is there an EFB management system in place?				
Does one person possess an overview of the complete EFB system and responsibilities within the operator's management structure?				
Crew procedures				
Is there a clear description of the system, its operational philosophy and operational limitations?				
Are the requirements for EFB availability in the operations manual and/or as part of the minimum equipment list (MEL)?				
Have crew procedures for EFB operation been integrated within the existing operations manual?				
Are there suitable crew cross-checks for verifying safety-critical data (e.g. performance, mass and balance (M&B) calculations)?				
If an EFB generates information similar to that generated by existing flight deck systems, do procedures identify which information will be primary?				
Are there procedures when information provided by an EFB does not agree with that from other flight deck sources, or, if more than one EFB is used, when one EFB disagrees with another?				
Are there procedures that specify what actions to take if the software applications or databases loaded on the EFB are out of date?				
Are there procedures in place to prevent the use of erroneous information by flight crews?				

Item	Assessment			
	YES	NO	N/C	NA
Is there a reporting system for system failures?				
Have crew operating procedures been designed to mitigate and/or control additional workload created by using an EFB?				
Are there procedures in place to inform maintenance and flight crews about a fault or failure of the EFB, including actions to isolate it until corrective action is taken?				
EFB risk assessment				
Has an EFB risk assessment been performed?				
Are there procedures/guidance for loss of data and identification of corrupt/erroneous outputs?				
Are there contingency procedures for total or partial EFB failure?				
Is there a procedure in the event of a dual EFB failure (e.g. use of paper checklist or a third EFB)?				
Have the EFB dispatch requirements (e.g. minimum number of EFBs on board) been incorporated into the operations manual?				
Have MEL or procedures in case of EFB failure been considered and published?				
Training				
Is the training material appropriate with respect to the EFB equipment and published procedures?				
Does the training cover the list of bulleted items in Chapter 4 — *Flight crew training*?				

APPENDIX C

EXAMPLE OF OPERATIONS SPECIFICATIONS AND OPERATIONS MANUAL CONTENT

When an EFB function is to be used for the safe operation of an aeroplane (see Chapter 6), an entry must be included in the operators operations specifications approved by the CAA. The operations specification will reference the location in the operations manual where the approved EFB applications are detailed. Figure C-1 shows an example of a specific approval EFB entry.

OPERATIONS SPECIFICATIONS (Subject to the approved conditions in the operations manual)				
SPECIFIC APPROVAL	YES	NO	DESCRIPTION	REMARKS
EFB for A/C type *Type1*			19 - Specifically approved EFB hardware and software applications for A/C type *Type1* are contained in [operations manual reference]	
EFB for A/C type *Type2*			- Specifically approved EFB hardware and software applications for A/C type *Type2* are contained in [operations manual reference]	
Other				
19. List of EFB functions with any applicable limitations.				

Figure C-1. Example of a specific approval EFB entry

Note.— Boxes YES/NO are not used since some EFB functions might not require an operational approval.
Other EFB functions not requiring an EFB approval should not be listed in the operations specifications form.

The EFB specific approvals referenced in the operations specifications form should have a companion detailed list of EFB-approved hardware and software applications. This list should be located in the operations manual in a table and be updated through the normal operations manual approval process established by the State. Figure C-2 contains an example of a companion EFB-specific approval table.

The "Approved hardware for A/C type" column of the companion *EFB (hardware and software) with specific approval table* should match the "DESCRIPTION" column of the operations specifications form. The "EFB applications" column of the table should list all the applications requiring a specific approval and include the application version, with any applicable limitations. The "Specific references and/or remarks" column of the table should include the application version in addition to any specific operations manual reference and other remarks if applicable.

EFB (hardware and software) with specific approval		
Approved hardware for A/C type	EFB applications *(List of EFB functions, versions and any applicable limitations.)*	Specific references and/or remarks
EFB for A/C type *Type1*	Aircraft performance calculation (take-off and landing) – *AppName1 ver x.x* Airport moving map – *AppName2 ver x.x* Charts application: En route – *AppName3 ver x.x* Airport charts (SID, STAR, approach) – *AppName4 ver x.x*	*See procedures in operations manual page X* *Back up: Quick Reference Handbook* *Refer to operations manual page X* *See operations manual page Y Paper back-up operation* *Paperless operation* *Refer to operations manual page Z*
EFB for A/C type *Type2*	– Charts application: En route – *AppName3 ver x.x*	*See operations manual page X Paper back-up operation*

Figure C-2. Example of a companion EFB specific approval table

APPENDIX D

EFB POLICY AND PROCEDURES MANUAL

These are the typical contents of an EFB policy and procedures manual that can be fully or partly integrated in the operations manual, if applicable.

The structure and content of the EFB policy and procedures manual should correspond to the size of the operator, the complexity of its activities and the complexity of the EFB used.

Introduction
EFB general philosophy EFB limitations
EFB approved hardware and software applications

EFB management Responsibilities Data management
Updates and changes management

Hardware description
EFB system architecture Hardware configuration control

Software description
Operating system description
List and description of applications hosted

Flight crew training

Operating procedures

Maintenance considerations

Security considerations