Trinidad and Tobago
Civil Aviation Authority

TTCAA Advisory Circular

Subject: ELECTRONIC FLIGHT BAG CERTIFICATION

Reference: TAC-054

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PURPOSE

1. This TTCAA advisory circular (TAC) contains guidance on the operational use of Electronic Flight Bags (EFBs). It is intended for all operators conducting flight operations who want to replace required paper information or utilize other select functions of an EFB. This TAC sets forth an acceptable means to obtain approval for the operational use of EFBs in accordance with **TTCAR No.2: 76A.**

APPROVED BY:

Francis Regis	Original signed by	28 June 2017
Director General of Civil Aviation	***Signature***	***Date***

CANCELLATION

2. The TAC cancels and supersedes **TAC-052** and **TAC-053**

ABBREVIATIONS

3.

"AEG":	*Aircraft Evaluation Group (FAA).*
"AIA":	*Accident Investigation Authority.*
"AMMD":	*Airport Moving Map Display.*
"ARP":	*Aerospace Recommended Practice (SAE Publication).*
"COTS":	*Commercial-Off-The-Shelf.*
***"**EFB":*	*Electronic Flight Bag.*
"GNSS":	*Global Navigation Satellite System*
***"**IEEE":*	*Institute of Electrical and Electronic Engineers (Global Organization for consensus building standards).*
"IEC":	*International Electrotechnical Commission (Provides international standards for electrotechnology.*
"M&B":	*Mass And Balance*
"NOTAM":	*Notices To Airmen*
"OEM":	*Original Equipment Manufacturer*
"OpSpecs":	*Operations Specifications*
***"**PED":*	*Portable Electronic Device.*
"RTCA":	*Radio Technical Commission for Aeronautics (US Federal Advisory Committee).*
"SAE":	*Society of Automotive Engineers*
"SAFO":	*Safety Alert For Operators (FAA Publication Alert).*
"T-PED":	*Transmitting Portable Electronic Device.*
"UL":	*Underwriters Laboratory (Global Organization collaborating on standards).*

DEFINITIONS

4. The following definitions are specific to this TAC and may differ from those definitions contained in other published references.:

a) **Administrative Control Process.** Operator-administered procedure to record and log the removal or addition of installed EFB components.

b) **Approved Software.** Software approved by the state of aircraft certification and may use the most current edition of RTCA/DO-178, Software Considerations in Airborne Systems and Equipment Certification, compliance, or other acceptable means.

c) **Class 1 Electronic Flight Bag (EFB) Hardware.** Portable commercial off-the-shelf (COTS)-based computers, considered to be portable electronic devices (PED) with no FAA design, production, or installation approval for the device and its internal components. Class 1 EFBs are not mounted to the aircraft, connected to aircraft systems for data, or connected to a dedicated aircraft power supply. Class 1 EFBs can be temporarily connected to an existing aircraft power supply for battery recharging. Class 1 EFBs that have Type B applications for

aeronautical charts, approach charts, or an electronic checklist must be appropriately secured and viewable during critical phases of flight and must not interfere with flight control movement.

Note: *Portable Class 1 EFB components are not considered to be part of aircraft type design (i.e., not in the aircraft type certificate (TC) or Supplemental Type Certificate (STC)).*

d) **Class 2 EFB Hardware.** Portable COTS-based computers, considered to be PEDs with no CAA design, production, or installation approval for the device and its internal components. Class 2 EFBs are typically mounted. They must be capable of being easily removed from or attached to their mounts by flight crew personnel. Class 2 EFBs can be temporarily connected to an existing aircraft power supply for battery recharging. They may connect to aircraft power, data ports (wired or wireless), or installed antennas, provided those connections are installed in accordance with the guidelines in **"APPENDIX 1"**.

Note: *Portable Class 2 EFB components are not considered to be part of aircraft type design (i.e., not in the aircraft type certificate (TC) or Supplemental Type Certificate (STC)).*

e) **Class 3 EFB Hardware.** EFBs installed in accordance with design approval from state of certification. Class 3 EFB hardware is not covered in this TAC.

f) **Critical Phases of Flight.** Includes all ground operations involving taxi, takeoff, and landing, and all other flight operations conducted below 10,000 feet, except cruise flight.

g) **Electronic Flight Bag (EFB).** An electronic display system intended primarily for flight deck or cabin crew member use that includes the hardware and software necessary to support an intended function. 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 airline's flight dispatch function. The scope of the EFB functionality may include various other hosted databases and applications. Physical EFB displays may use various technologies, formats, and forms of communication. An EFB must be able to host and actively display Type A and/or Type B software applications.

h) **Hosted Application.** Software running on an EFB that is not installed or considered part of aircraft type design.

i) **Interactive Information.** Information presented on the EFB that, via software applications, can be selected and rendered in several dynamic ways. This includes variables in the information presented based on data-oriented software algorithms, concepts of decluttering, and selectable composition as opposed to pre-composed information.

j) **Mounted.** Any portable device that is attached to a permanently installed mounting device.

k) **Mounting Device.** These include arm-mounted, cradle, clips, docking stations, etc.

l) **PED.** There are two (2) types of PEDs and there are two (2) methods of compliance with the regulations.

1) The non-EFB PED method of compliance with PED regulations is not covered in this TAC.
2) The EFB PED method of compliance with TTCAA EFB regulations and guidance documented in this TAC.

NOTE: *For a PED to be considered an EFB, the PED must host and actively display Type A, B, and/or C software applications as applicable, and requires the issuance of Operations Specifications (OpSpec) paragraph A061 "Use of Electronic Flight Bag."*

m) **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.

n) **Stowed.** A portable device that is placed in a secure stowage location but is not available for use or view by the pilot in that location.

o) **Transmitting Portable Electronic Devices (T-PED).** PEDs that have intended radio frequency (RF) transmission capabilities.

p)

q) **Type A Software Applications.** Type A software applications are those paper replacement applications primarily intended for use during flight planning, on the ground, or during noncritical phases of flight having a failure condition classification considered to be a minor hazard or less. **Table 1** lists examples of Type A software applications.

r) **Type B Software Applications.** Type B software applications are those paper replacement applications that provide the aeronautical information required to be accessible for each flight at the pilot station and are primarily intended for use during flight planning and all phases of flight. Type B applications include miscellaneous, nonrequired applications (e.g., aircraft cabin and exterior surveillance video displays, maintenance applications) having a failure condition classification considered to be a minor hazard or less. **Table 2** lists examples of Type B software applications.

s) **Type C Software Applications.** Type C software applications are approved by the state of certification and may use RTCA/DO-178 or another acceptable means. These are "non-EFB" software applications found in avionics and include intended functions for communications, navigation, and surveillance that require state of design CAA, production, and installation approval. Type C applications are approved software for surface and airborne functions with a failure condition classification considered to be a major hazard or higher. Type C software applications are not covered in this TAC.

t) **Viewable Stowage.** A portable device that is secured in an existing provision with the intended function to hold charts or acceptable temporarily secured portable device viewable to the pilot (e.g., kneeboards, suction cups, etc.).

TABLE 1 – EXAMPLES OF TYPE A SOFTWARE APPLICATIONS

- Pilots Operating Handbook (POH)
- Flight Attendant (F/A) manuals. (If no flight operating procedures.)
- Company standard operating procedures (SOP).
- Airport diversion policy guidance, including a list of special designated airports and/or approved airports with Emergency Medical Services (EMS) support facilities.
- Operations specifications (OpSpecs).
- Cockpit observer briefing cards.
- For smaller aircraft, pilot's operating handbooks (POH), including POH section IX supplements.
- Aircraft performance data manuals (fixed non-interactive material).
- Airport performance restrictions manual (e.g., a reference for takeoff and landing performance calculations).
- Weight and Balance (W&B) manual, if a separate manual (fixed non-interactive material).
- Other aircraft performance data manuals, including specialized performance data for use in conjunction with advanced wake vortex modeling techniques, land-and-hold-short operations (LAHSO) predictions, etc. (fixed non-interactive material for planning purposes).
- Maintenance manuals.
- Aircraft maintenance reporting manuals.
- Aircraft flight log and servicing records.
- Autopilot approach and autoland records.
- Flight management system (FMS)/flight management and guidance system problem report forms.
- Aircraft parts manuals.
- Service Bulletins (SB)/published Airworthiness Directives (AD), etc.
- Minimum equipment lists (MEL).
- Configuration Deviation Lists (CDL).
- Country 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) filed differences.
- Aeronautical Information Publications (AIP).
- Aeronautical Information Manual (AIM).
- Oceanic navigation progress logs.
- Pilot flight and duty-time logs.
- Flight crew required rest logs.
- Flight crew qualification logs (such as aircraft qualifications, Class II flight crew qualifications, Category (CAT) III qualifications, high minimums logs, night currency logs, pilot-in-command (PIC) qualifications for special areas, routes, and airports and special airports qualifications).
- Captain's report (i.e., captain's incident reporting form).
- Flight crew survey forms (various).
- Trip scheduling and bid lists.
- Aircraft captain's logs.

- Aircraft's CAT II/CAT III landing records.
- Antiterrorism profile data.
- Hazardous materials (hazmat)/oxidizer look-up tables.
- ICAO DOC 9481, Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods.
- Customs declaration.
- Special reporting forms, such as ASRs, etc.
- Incidents of interference to aircraft electronic equipment from devices carried onboard aircraft. Current fuel prices at various airports.
- Realistic training modules, including "personal computer (PC) at home" training applications, "off-duty" training materials review, and preflight "mission" rehearsals.
- Check pilot and flight instructor records.
- Aircraft operating and information manuals (performance information, W&B, systems, limitations, etc.).
- Airline Policy and Procedures Manuals.
- Aircraft Maintenance Manuals.
- TTCARs.
- Look up and completion of various reporting forms; e.g., company-specific forms.
- Maintenance personnel signoff of discrepancy form. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Flight crew qualifications recordkeeping, including aircraft qualifications, CAT II/III, high minimums, landing currency, flight time and duty-time, etc.
- PIC currency requirements.
- Passenger information requests—some are directed to the gate or to the agent meeting the flight (e.g., special meal requests, wheelchair requirements, unaccompanied minors, gate information for connecting flights, flights being held for connecting passengers).
- Cabin maintenance writeups. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Approved electronic signature using public key infrastructure private key technology.

TABLE 2 – EXAMPLES OF TYPE B SOFTWARE APPLICATIONS

- Airplane Flight Manuals (AFM) (or Rotorcraft Flight Manuals (RFM)) and Airplane Flight Manual Supplement (AFMS).
- Flight Attendant (F/A) manuals that include flight operating procedures.
- Flight Crew Operations Manuals (FCOMs), including emergency procedures.
- Company Operations Manual.
- 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.
- Power settings for reduced thrust settings.
- Runway limiting performance calculations.
- Cost index modeling.
- Master flight plan/updating.
- Interactive plotting for Class II navigation.

- Mission rehearsals.
- Weight and Balance (W&B) calculations.
- Maintenance discrepancy signoff logs. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Cabin maintenance discrepancy reporting forms/location codes. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Non-interactive electronic approach charts in a precomposed format from accepted sources.
- Panning, zooming, scrolling, and rotation for approach charts.
- Precomposed or dynamic interactive electronic aeronautical charts (e.g., en-route, area, approach, and airport charts) including, but not limited to, centering and page turning, but
- without display of airborne aircraft/own-ship position.
- Precomposed or dynamic interactive airport surface electronic aeronautical charts (e.g., airport moving maps) including, but not limited to, centering, page turning, and airport surface aircraft/own-ship position at speeds less than 80 knots (kts), but without display of airborne aircraft/own-ship position (i.e., not appropriate for: surface navigation, surface alerting, time-based operations, guidance, maneuvering, and control functions, etc.).
- Electronic checklists, including normal, abnormal, and emergency.
- Applications that make use of the Internet and/or other Aeronautical/Airline Operational Control or company maintenance-specific data links to collect, process, and then disseminate data for uses such as spare parts and budget management, spares/inventory control, unscheduled maintenance scheduling, etc. (Maintenance discrepancy logs need to be downloaded into a permanent record at least weekly.)
- Weather and aeronautical data.
- Aircraft cabin and exterior video surveillance displays.

GENERAL

5. (1) **Background.** All PEDs are subject to these restrictions unless they are authorized EFBs. To be an authorized EFB, the PED must host one or more of the authorized EFB functions listed in "**TABLE 1"** and "**TABLE 2"** and meet the additional required evaluation criteria. Class 1 and Class 2 EFBs are both considered PEDs. The use of any PED as an authorized EFB in an aircraft is subject to compliance with Electronic Flight Bag regulation **TTCAR 2:76A.** For guidance on the installation of components see **"APPENDIX 1".**

(2) **Applicability.** One of the major motivators for using an EFB is to reduce or eliminate the need for paper and other reference materials in the cockpit. This TAC describes the EFB functions, features, and selected hosted applications, and applies to the authorization for use of both portable and installed EFBs.

(3) **Scope.** The primary intent of the guidance material described in this TAC is to assist operators and flight crews in transitioning from the paper products in a traditional flight bag to an electronic format. The intent of this TAC is to provide specific guidance material for certain EFB applications and to establish guidance for operational use of EFBs by flight deck crewmembers and other crewmembers in the cabin. The intention of this TAC is not to supersede existing operational guidance material. Do not use this TAC to add own-ship

position in-flight on Class 1 and Class 2 EFBs. If you use the means described in this TAC to display own-ship position on the airport surface on an EFB, you must follow it entirely.

(4) **Related Reading Materials.** See **APPENDIX 2** for a list of references.

DISPLAY OF OWN-SHIP POSITION

6. The display of an own-ship symbol limited to the airport surface is identified by this TAC as a Type B software application and limited to functions having a failure condition classification considered to be a minor hazard or less, and only for use at speeds of less than 80 knots (kts). Type B software applications using own-ship may be considered only an aid to situational awareness; no use in operations other than an aid to situational awareness will be authorized (i.e., not appropriate for: surface navigation, surface alerting, time-based operations, guidance, maneuvering, and control functions, etc.). Display of own-ship position on the airport surface as a Type B application is intended to help flight crews orient themselves on an airport chart/map, and to improve pilot positional awareness during taxi takeoff, and upon landing. Type B software applications using display of own-ship position on the airport surface are not sufficient to be used as the basis for operational guidance, maneuvering, and control, and assume compliance with the operational guidelines in the Operations Manual. Airborne and surface functions with a failure condition classification of major hazard or higher, which includes depiction of own-ship position in-flight, require *"Approved Software"*.

CLASS 1 EFB HARDWARE

7. These EFBs are portable COTS devices that are not mounted to the aircraft. Class 1 EFBs do not Have dedicated power connectivity and have no data connectivity with installed aircraft systems. Class 1 EFBs that have Type B applications for aeronautical charts, approach charts, or Electronic Checklists, must be appropriately secured and viewable during critical phases of flight and must not interfere with flight control movement or pilot egress. An EFB that is temporarily secured may still be considered a Class 1 EFB if it is not mounted to the aircraft. The operator must document EFB non-interference to show operational suitability and compliance of this TAC when intended for use in all phases of flight. For Class 1 devices with Type A applications that are not required in critical phases of flight, the operator must document EFB non-interference to show operational suitability and compliance with the guidance in this AC.

CLASS 2 EFB HARDWARE

8. These EFBs are typically mounted to the aircraft by a mounting device and may be connected to a data source, a hardwired power source, and an installed antenna, provided those connections are installed in accordance with applicable airworthiness regulations. To be considered portable, the EFB must be removable from the flight deck without the use of tools, and a pilot crewmember must be able to perform the task. Portable EFBs must be located on the flight deck and controlled by the flight crew or, as applicable, in the cabin and controlled by the cabin crew during all flight operations. Although attached to the aircraft via a mounting device, Class 2 EFB hardware must be accessible to the flight crew and must be removable without the use of tools. The components of the Class 2 EFB include all the hardware and software needed to support EFB intended functions. A

Class 2 EFB may consist of modular components (e.g., computer processing unit, display, controls). Any EFB hardware not accessible to the flight crew on the flight deck and/or not portable must be installed in accordance with the applicable airworthiness regulations. For guidance on the installation of EFB components, refer to **"APPENDIX 1"**.

NOTE: *Portable EFBs are limited to hosting Type A and Type B software applications with intended functions limited to a minor failure effect classification. However, Type B software applications using a depiction of an own-ship symbol are limited to airport surface operations only and to speeds of less than 80 kts ground speed.*

1) The operator must document EFB non-interference compliance as part of the EFB authorization process if Type A, B, or C software applications will be used during a critical phase of flight. Operators must also determine non-interference and operational suitability with existing aircraft systems for all flight phases and ensure that the system performs the intended function.

2) TTCAA airworthiness approval is limited to the aircraft connectivity provisions (i.e., mounting device (e.g., arm-mounted, cradle, yoke-clip), data connectivity, installed antennas, and power connection) installed in accordance with applicable airworthiness regulations.
   - EFB mounting installation requires TTCAA approval for the integrity of mounting, location, non-impeded egress, accessibility to instruments and controls, physical interference, etc.
   - EFB data connections require TTCAA approval to ensure non-interference and isolation from aircraft systems during transmission and reception. The EFB may receive information from any aircraft system, as well as transmit or receive information for Airline Administrative Control/Airline Operational Communications purposes. Connectivity may be wired or wireless. Refer to **"APPENDIX 1"**.
   - Class 2 EFB hardware, internal components, and software do not require TTCAA airworthiness approval.

3) Class 2 EFB mounting devices, installed antennas, power connections, and data connectivity provisions installed in accordance with TTCAA applicable airworthiness regulations and may require Airplane Flight Manual or Airplane Flight Manual Supplement revisions.

4) Removal/attachment of a Class 2 EFB from the aircraft may be completed by the flight crew without maintenance tasks through an administrative control process if the EFB is assigned to the aircraft (e.g., logbook entry) or the EFB may be assigned to the pilot without administrative control.

CLASS 3 EFB HARDWARE

9. EFBs installed in accordance with the applicable aircraft certification and airworthiness regulations.

Note: *For guidance on the installation of **Class 1** and **Class 2** EFB components, refer to **"APPENDIX 1"**.*

TYPE A EFB SOFTWARE APPLICATION

10. **"TABLE 1"** lists examples of EFB-hosted software applications. Type A software applications include precomposed, fixed presentations of data currently presented in paper format. Type A applications are typically intended to be used on the ground or during noncritical phases of flight having a failure condition classification considered to be a minor hazard or less. The operator must possess evidence demonstrating that operational requirements are met when using the applications listed in **"TABLE 1"**.

(1) Type A application software does not require compliance with RTCA/DO-178.

(2) Type A application software may reside on any EFB hardware classification (Class 1, 2, or 3).

(3) The operator can use the application after successful completion of the user/operator evaluation (including flight crew training, checking, and currency requirements).

(4) Type A application software for Mass and Balance (M&B) are applications that present existing information found in the applicable AFM, pilot's operating handbook (POH), or M&B manual. These Type A applications are exact electronic replications of the printed document they replace (e.g., PDF files).

(5) Type A application software for aircraft performance are applications that present existing information found in the applicable AFM or POH. These Type A applications are electronic replications of the printed document they replace (e.g., PDF files).

(6) Operators must determine the usage of hardware and/or software architectural features, people, procedures, and/or equipment to eliminate, reduce, or control risks associated with an identified failure in a system.

(7) The operator should provide evidence demonstrating that the EFB operating system and hosted application software can perform the intended function and do not provide false or hazardously misleading information. This evidence includes demonstration that software revisions will not corrupt the data integrity of the original software performance.

TYPE B EFB SOFTWARE APPLICATION

11. **"TABLE 2"** lists examples of EFB-hosted software applications. Type B applications include dynamic, interactive applications that can manipulate data and presentation for operationally required and other paper reference materials. Type B applications are applications that are intended for use during critical phases of flight having a failure condition classification considered to be a minor hazard or less. The operator must provide evidence demonstrating that the operational requirements are met when using the applications listed in **"TABLE 2"**.

1) Type B application software does not require compliance with RTCA/DO-178.

2) Type B application software may reside on any EFB hardware classification (Class 1, 2, or 3).

3) The operator can use the application after successful completion of the user/operator evaluation (including flight crew training, checking, and currency requirements).

4) Type B applications are used to display precomposed or interactive information such as navigation or approach charts, as well as depiction of an own-ship symbol limited to airport surface operations only at speeds of less than 80 kts gorund speed. Required flight information should be readily available for display for each applicable phase of flight. Depiction of own-ship position limited to airport surface operations at speeds of less than 80 kts ground speed can be authorized if the operator properly evaluates them.

NOTE: *Class 1 or Class 2 EFBs must not display own-ship position while in flight.*

(a) Operators must determine the usage of hardware and/or software architectural features, people, procedures, and/or equipment to eliminate, reduce, or control risks associated with an identified failure in a system.

(b) The operator should provide evidence demonstrating that the EFB operating system and hosted application software can perform the intended function and do not provide false or hazardously misleading information. This evidence includes a demonstration that software revisions do not corrupt the data integrity or intended function of the original installed software configuration.

(c) Data link EFB functions may display approved sources of weather for strategic/flight planning purposes. Weather and aeronautical information such as data-linked meteorology information (MET) and Aeronautical Information Service (AIS) products are for advisory use only. These products enhance situational awareness, but lack the service delivery reliability and updating necessary for tactical maneuvering/use. *Do not* use data-linked MET and AIS products as a sole source for making tactical in-flight decisions regarding flight safety when avoiding adverse weather, airspace, or obstacle hazards (e.g., negotiating a path through a weather hazard area). Current data-linked MET and AIS products may support strategic decision making (e.g., route selection to avoid a weather hazard area in its entirety).

(d) Data link graphical weather from sources such as XM radio and next generation weather radar (NEXRAD) may be from approved sources of advisory weather information and can only be used for strategic/flight planning purposes. Do not use data link graphical weather information for tactical decisions during critical phases of flight, because data quality is uncontrolled for aviation use. Do not use data link graphical weather data as a substitute for airborne weather radar or thunderstorm detection equipment.

(e) Type B applications for M&B are software applications based on the existing information found in the State of certification approved AFM, POH, or M&B manual for an aircraft. Type B M&B applications use data management software to provide data reference and mathematical calculations to simplify determination of aircraft M&B. Type B M&B applications adhere to existing approved data and must be validated for accuracy in the entire aircraft operating envelope. Type B M&B applications may use algorithms to calculate M&B results or may use basic mathematics combined with data spreadsheets

to determine M&B results. Algorithms may have the ability to interpolate data but *must not* extrapolate, and therefore must be tested and proven accurate by the manufacturer or operator to represent the AFM- or Rotorcraft Flight Manual (RFM)-approved data. Type B M&B applications are produced for a specific aircraft and based on AFM-approved data.

(f) Type B applications for performance are software applications based on existing published data as found in the State of Certification approved AFM, POH, or performance manual for an aircraft. Type B performance applications use data management software to provide data reference and mathematical calculations to simplify determination of applicable aircraft performance data. Type B performance applications must adhere to this published data and must be validated for accurate determination of aircraft performance for the entire operating envelope. Type B aircraft performance applications may use algorithms to calculate results or may use data spreadsheets to determine results. Algorithms may have the ability to interpolate but must not extrapolate beyond the information contained in the current published data. These algorithms must be tested and verified to meet the existing State of Certification approved AFM performance data. Type B performance applications must not extrapolate or project results not represented by the AFM-approved data point's envelope of conditions including, but not limited to, pressure, altitude, temperature, and weight. Type B aircraft performance applications are produced for a specific aircraft type based on approved AFM data.

(g) Type B M&B and/or performance software applications require validation testing prior to EFB operational use. Applications using data spreadsheets where each data point is entered into software data and then referenced for output must be verified for accurate data selection. Applications based on algorithms that calculate output must be verified to accurately represent the AFM data they replace. Creation of a new algorithmic method to replace AFM data is not allowed in Type B applications. Type B algorithms must adhere to the same data methodology as the AFM-approved data. The Type B application must always be demonstrated to be traceable to the paper AFM-approved data. These Type B applications must not allow entry input or output of data outside the AFM data envelope(s). Sufficient data points based on application architecture must be tested and documented to show that the applications accurately adhere to and are limited to the AFM-approved data envelope segments and, for performance, must represent net climb gradients with considerations including, but not limited to, level-off, acceleration, transitions, and engine takeoff power time limits. Type B applications for performance must accurately address engine inoperative gradients and obstacle clearance plane and/or weight limits. Transition from airport area performance to en-route climb performance and obstacle clearance must be addressed. Type B applications are suitable only insofar as they accurately reproduce the paper AFM data.

(h) The Operator must develop operational procedures for use in aircraft. These procedures should define the roles that the flight crew and dispatch/flight following have in creating and reviewing performance calculations. Operations specifications (OpSpecs) must be issued as appropriate.

(i) Type B applications require a validation period to ensure the reliability of the EFB functions prior to the removal of the applicable paper documents. Operational procedures must be established to verify the accuracy of inputs and outputs of Type B application software. Validation is a necessary part of risk mitigation to ensure the effective function and reliability of EFB hardware, software, and procedures. A validation report documenting results of the validation period must be completed and available prior to removal of the applicable paper documents.

TYPE C EFB SOFTWARE APPLICATION

12. Type C software applications are not covered in this TAC.

PORTABLE EFB HARDWARE CONSIDERATIONS

13. Paper Data Removal. Two (2) or more operational EFBs are required to remove paper products that contain Type B software applications for in-flight use (e.g., aeronautical charts, checklists, emergency procedures, etc.) Type A software applications are not subject to this requirement. The design of the EFB function requires that no single failure or common mode error may cause the loss of required aeronautical information.

14. Electrical Power Source. System design must consider the source of electrical power, the independence of the power sources for multiple EFBs, and the potential need for an independent battery source. Battery-powered EFBs that have aircraft power available for recharging the EFB battery are considered to have a suitable backup power source. EFBs that do not have a battery power source and that are used in place of paper products required by the operating rules are required to have at least one EFB connected to an aircraft power bus. For guidance on the design and installation of aircraft electrical power sources, refer to **"APPENDIX 1"**.

15. Battery Backup. Useful battery life must be established and documented for battery powered EFBs. Aircraft operators must be able to determine the useful life of the EFB battery. Each battery powered EFB providing aeronautical information or software applications pertinent to the safe operation of the aircraft must have at least one of the following before departing the gate:

(1) An established procedure to recharge the battery from aircraft power during flight operations; or

(2) A battery or batteries with a combined useful battery life to ensure EFB is operational during taxi and flight operations to include diversions and expected delays; or

16. Battery Replacement. In the case of a replaceable battery, if the EFB manufacturer has not specified a battery replacement interval, then the original battery (or cell) manufacturer's specified replacement interval should be adhered to.

17. Lithium Batteries. Rechargeable lithium-type batteries are becoming more common as a source of principal power or standby/backup power in EFBs. Lithium-ion or lithium-polymer (lithium-ion

polymer) batteries are two types of rechargeable lithium batteries commonly used to power EFBs. The word "battery" used in this TAC refers to the battery pack, its cells, and its circuitry.

1) **Safety Concerns.** These types of batteries are vulnerable to overcharging and over-discharging, which can (through internal failure) result in overheating. Overheating may result in thermal runaway, which can cause the release of either molten burning lithium or a flammable electrolyte. Once one cell in a battery pack goes into thermal runaway, it produces enough heat to cause adjacent cells to also go into thermal runaway. The resulting fire can flare repeatedly as each cell ruptures and releases its contents. For additional information on fighting fires caused by lithium-type batteries in portable electronic devices see SAFO 09013.

2) **Design Recommendation.** We recommend the rechargeable lithium-type battery design be compliant with the provisions of the Institute of Electrical and Electronic Engineers (IEEE) 1625-2008, IEEE Standard for Rechargeable Batteries for Portable Computing. This standard drive design considerations for system integration, cell, pack, host device, and total system reliability. It also covers how to maintain critical operational parameters with respect to time, environment, extremes in temperature, and the management of component failure.

3) **Related Regulations.** There are other regulations that may apply to the use of lithium batteries onboard aircraft, including IATA Transport of Dangerous Goods.

4) **Lithium Battery Safety and Testing Standards.** Due to their proximity to the flight crew and potential hazard to safe operation of the aircraft, the use of rechargeable lithium-type batteries in portable EFBs located in the aircraft cockpit call for the following standards. Operators must provide evidence of the following testing standards to determine whether rechargeable lithium-type batteries used to power EFBs are acceptable for use and for recharging. Operators must provide evidence of the standards. Refer to the following current editions:

(a) **United Nations (UN) Transportation Regulations.** UN ST/SG/AC.10/11/Rev.5-2009, Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria.

(b) **Underwriters Laboratory (UL).** UL 1642, Lithium Batteries; UL 2054, Household and Commercial Batteries; and UL 60950-1, Information Technology Equipment - Safety.
NOTE: *Compliance with UL 2054 indicates compliance with UL 1642.*

(c) **International Electrotechnical Commission (IEC).** International Standard IEC 62133, Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications.

(d) **RTCA/DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems.** An appropriate airworthiness testing standard such as RTCA/DO-311 can be used to address concerns regarding overcharging, over-discharging, and the flammability of cell components. RTCA/DO-311 is intended to test permanently installed equipment; however, these tests are applicable and sufficient to test EFB rechargeable lithium-type batteries. If RTCA/DO-311 is used, then RTCA/DO-311 Table 4-1 and appendix C should be used for guidance on applicable testing.

5) **Showing Compliance.** The operator provides the TTCAA Project Manager (PM) with records of compliance to these battery standards during the authorization to use the EFB. These records may be available from the battery's Original Equipment Manufacturer (OEM).

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

7) **Use of Aircraft Electrical Power Sources.** Appropriate labels should identify the electrical characteristics (e.g., 28 volts direct current (VDC), 1500 milliAmps (mA), 60 or 400 hertz (Hz)) of electrical outlets for Class 2 portable EFB electrical connections. Conduct an electrical load analysis to replicate a typical EFB to ensure that powering or charging the EFB will not adversely affect other aircraft systems and that power requirements remain within power load budgets. Additional actions and application of airworthiness regulations are not applicable to the internal elements of Class 1 and Class 2 EFBs unless specified in this TAC. For guidance on the use of aircraft electrical power sources, refer to **"APPENDIX 1"**.

18. Environmental Hazards Identification and Qualification Testing. Certain environmental hazards must be evaluated for Class 1 and Class 2 EFBs to ensure their safe use in anticipated operating environments. Evaluate Class 1 and Class 2 EFB system RF emissions data needs in accordance with this TAC. Class 1 and Class 2 EFBs should demonstrate that they meet appropriate industry-adopted environmental qualification standards for radiated emissions for equipment operating in an airborne environment (RTCA/DO-160, Environmental Conditions and Test Procedures for Airborne Equipment, or its equivalent). It is necessary to demonstrate that any Class 1 or Class 2 EFB used in aircraft flight operations will have no adverse impact on other aircraft systems (noninterference). The manufacturer, installer, or operator may accomplish the testing and validation to ensure proper operation and noninterference with other installed systems. Test for possible interference while moving a portable EFB about in the cockpit. Additionally, rapid decompression testing may need to be accomplished to demonstrate Class 1 or Class 2 EFB operation for use in pressurized aircraft.

1) **Non-EFB Noninterference Testing.** It is the user's/operator's responsibility to determine that the operation of a PED will not interfere in any way with the operation of aircraft equipment. Class 1 and Class 2 EFBs require the additional guidance for noninterference testing contained in this TAC.

2) **EFB PED Noninterference Compliance Test Method.** In order to operate a PED during all phases of flight, the user/operator is responsible for ensuring that the PED will not interfere in any way with the operation of aircraft navigation and communication system. The following methods are applicable to Class 1 and Class 2 EFBs that are to remain powered (including being

in standby mode) during critical phases of flight. The user/operator may use either Method 1, Method 2, or Method 3 for noninterference testing.

a) **Method 1.** The two following steps complete Method 1 for compliance with PED noninterference testing for all phases of flight.

(1) Step 1 is to conduct an electromagnetic interference (EMI) test in accordance with RTCA/DO-160, section 21, category M. An EFB vendor or other source can conduct this Step 1 test for an EFB user/operator. An evaluation of the results of the RTCA/DO-160 EMI test can be used to determine if an adequate margin exists between the EMI emitted by the PED and the interference susceptibility threshold of aircraft equipment. If Step 1 testing determines that adequate margins exist for all interference (both front door and back door susceptibility), then Method 1 is complete. It is necessary to complete Step 2 testing if Step 1 testing identifies inadequate margins for interference, or either front door or back door susceptibility. (Front door emissions couple to aircraft system antennas by means of propagation through aircraft apertures such as doors and windows. Back door emissions couple to aircraft equipment, wires, and cables).

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

b) **Method 2.** For compliance with PED non-interference testing for all phases of flight is a complete test in each aircraft using an industry standard checklist. This industry standard checklist must be of the extent normally considered acceptable for non-interference testing of a PED in an aircraft for all phases of flight. Testing for a particular aircraft make/model may be credited to other similarly equipped aircraft of the same make/model.

c) **Method 3.** For compliance with PED non-interference testing for all phases of flight is the methodology described in FAA InFO 13010 - Expanding Use of Passenger Portable Electronic Devices (PED), and its supplement FAA InFO 13010SUP- TTCAA Aid to Operators for the Expanded Use of Passenger PEDS. This guidance is an acceptable means of assessing and mitigating risk pertaining to the use of PEDs in all phases of flight. If an aircraft has been determined to be eligible for all phases of operation, without restriction, for passenger PEDs, then the same determination of electromagnetic compatibility may apply to PEDs that have been authorized for use.

3) Transmitting Portable Electronic Devices (T-PED). In order to operate a T-PED in other than a noncritical phase of flight, the user/operator is responsible to ensure the T-PED will not interfere with the operation of the aircraft equipment in any way. The following method is applicable to all Class 1 or 2 EFBs with Type B software applications required for use during all

phases of flight. Non-interference testing for T-PEDs consists of two separate test requirements:

a) **Test Requirement 1.** Each T-PED must have a frequency assessment based on the frequency and power output of the T-PED. This frequency assessment must consider Trinidad and Tobago frequency standards and be in accordance with applicable processes set forth in RTCA DO-294, Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDs) on Aircraft. This frequency assessment must confirm no interference of aircraft or ground equipment will occur as a result of intentional transmissions from these devices.

b) **Test Requirement 2.** Once a frequency assessment determines there will be no interference from the T-PED's intentional transmissions, each T-PED must then be tested while operating using either Method 1 or Method 2 for basic non-interference testing requirements described above. This basic non-interference testing is applicable to both a T PED integrated into an EFB device and a T-PED remote to an EFB. When a T-PED is integrated into an EFB, the basic non-interference testing must be completed both with and without the T-PED function being operative. If a T-PED is located remote from the EFB, the T-PED basic non-interference testing is independent from the EFB non-interference testing. T-PED position is very critical to T-PED non-interference testing.

4) Rapid Decompression Testing.

a) **Environmental Tests.** Other environmental testing, specifically testing for rapid decompression, may be necessary. Testing completed on a specific representative EFB make and model configuration may be applied to other EFBs of the same make and model. It is the responsibility of the operator to provide documentation that these tests have been accomplished on at least one representative sample of each make and model of the EFB. Representative testing is an appropriate level of testing for modern solid-state devices. The testing of operational EFBs should be avoided when possible to preclude the infliction of unknown damage to the unit during testing.

b) **Rapid Decompression Testing.** Determining an EFB device's functional capability requires rapid decompression testing when utilizing Type B software applications in pressurized aircraft, unless alternate procedures or a paper backup is available. When using only Type A applications on the EFB, rapid decompression testing is not required. The information from the rapid decompression test is used to establish the procedural requirements for the use of that EFB device in a pressurized aircraft. Rapid decompression testing must comply with RTCA/DO-160 guidelines for rapid decompression testing up to the maximum operating altitude of the aircraft in which the EFB is to be used. EFB units of the same make and model that have already been tested may be used to comply with this requirement.

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

decompression while turned on, no mitigating procedure needs to be developed beyond dual redundancy. If a Class 1 or Class 2 EFB device demonstrates rapid decompression testing while turned off and is fully functional following rapid decompression, then procedures will need to be developed to ensure that one of the two (2) EFBs onboard the aircraft remains off or configured so that no damage will be incurred should rapid decompression occur in flight above 10,000 feet.

(2) **Unpressurized Aircraft.** Rapid decompression testing is not required for a Class 1 or Class 2 EFB used in an unpressurized aircraft. The EFB must be demonstrated to reliably operate up to the maximum operating altitude of the aircraft. If EFB operation at maximum operating altitude is not attainable, procedures must be established to preclude operation of the EFB above the maximum demonstrated EFB operation altitude while still maintaining availability of required aeronautical information.

19. EFB Mounting Devices. For guidance on the design and installation of EFB mounting devices, refer to **"APPENDIX 1".**

20. Stowage Area for EFB. EFB stowage is required for all EFBs not secured in or on a mounting device. If an EFB mounting device is not provided, designate an area to stow the EFB. Stowage requires an inherent means to prevent unwanted EFB movement when not in use. Do this in a manner that prevents the device from jamming flight controls, damaging flight deck equipment, or injuring flight crew members should the device move about because of turbulence, maneuvering, or other action. The stowage area should not obstruct visual or physical access to controls and/or displays, flight crew ingress or egress, or external vision. Acceptable stowage locations for a Class 1 EFB include the inside compartments of the pilot's stowed flight bag.

21. Data Connectivity with Aircraft Systems (Wired or Wireless). For guidance on the design and installation of any EFB data connectivity with aircraft systems, either wired or wireless, refer to **"APPENDIX 1"**. Hardware and software for data connection provisions and interface protection devices must be incorporated into the aircraft type design per **"APPENDIX 1"**.

EFB DESIGN CONSIERATIONS

22. a) **EFB System Design and Usability.** It is necessary to evaluate the human factors/pilot interface characteristics of the EFB system. Special attention should be paid to new or unique features that may affect pilot performance.

b) **Human Machine Interface.** The EFB user interface should be consistent and intuitive within and across various EFB applications. The interface design (including, but not limited to, data entry methods, color-coding philosophies, terminology, and symbology) should be consistent across the EFB and various hosted applications.

c) **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. Brightness should be adjustable in fine increments. In addition, when incorporating an automatic brightness adjustment, it should operate independently for each EFB in the flight deck. Buttons and labels should have adequate illumination for night use. All controls must be properly labeled for their intended function. Consideration should be given to long-term display degradation due to abrasion and aging. The EFB should not produce objectionable glare or reflections that could adversely affect the pilot's visual environment.

d) **Electronic Display of Aeronautical Charts.**

1) Electronic aeronautical charts should provide a level of information comparable to paper charts.

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

(b) The screen must display an instrument approach procedure chart in an acceptable aeronautical chart format similar to a published paper chart. The screen must be large enough to show the entire standard format one-page IAP chart all at once, with a degree of legibility and clarity equivalent to that of a paper chart. This requirement is not meant to preclude panning and zooming features, but is intended to prevent a workload increase during the approach phase of flight. Alternate representations of IAP charts will need to be evaluated for operational suitability by the AEG for functionality and human factors.

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

NOTE: *Software with an airworthiness approval performing an intended function of aeronautical charting as a replacement for paper could be utilized to support operational requirements without the need for further operational evaluation for use, provided it meets the EFB system design configuration considerations in this paragraph.*

2) The FSB/OSR report should include, but not be limited to, the following:

- Aeronautical information operational suitability;

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

e) **Database Accuracy and Quality.** Database errors can have a significantly greater impact on the flight crew than other elements of the EFB system. With this in mind, the EFB system should have a database with appropriate quality control (QC) systems, and should be based on accuracy standards to avoid the potential presentation of hazardously misleading information. When developing the database and data quality requirements, we recommend the use of RTCA/DO-200A, Standards for Processing Aeronautical Data. Databases utilizing raster aeronautical charts should use the guidance in RTCA/DO-257A, Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps, appendix F, to determine the level of accuracy and resolution supported, as well as guidance on the appropriate use of colors for raster aeronautical charts. A means to identify the database version, effective date, and valid operating period must be provided. For Type B software applications displaying own-ship position intended for airport surface operations, design of the system should never exceed a maximum total error budget of 40 meters accuracy for the combination of database error and position source error. The 40-meter accuracy requirement is based on half the separation of taxiways at aerodrome code letter E as specified in ICAO Annex 14. A statement of the quality control processes applied and database accuracy by the database manufacturer should suffice for determination of database error contribution to the total error budget.

f) **Own-Ship Position Source and Display Characteristics.** The use of an installed Global Navigation Satellite System (GNSS) position source is recommended. Portable EFBs with no data access to installed aircraft systems may consider use of a portable (internal or external) GNSS source, pending completion of a successful evaluation. Type B software applications, which display own-ship position limited to airport surface operations, may be utilized pending successful evaluation of the application software for operational suitability and must be tested and proven accurate by the applicant utilizing the Type B Electronic Flight Bag (EFB) Software Application(s) Displaying Own-ship Position Limited to Airport Moving Map for Surface Operations. To display own-ship position, the Type B application software must incorporate the following design features and limitations:

(1) **Airborne Display.** Removal of own-ship when calculated speed exceeds 80 kts ground speed. This ensures no own-ship when airplane is airborne, even if aircraft is within the airport diagram boundary.

(2) **Airport Map.** For design of an AMMD with own-ship depiction, we recommend using appropriate elements of RTCA/DO-257A. When developing the AMMD application and

the data quality requirements, the applicable requirements of RTCA/DO-272C, User Requirements for Aerodrome Mapping Information, section 3 should be utilized. Type B application software displaying own-ship position limited to airport surface operations must perform its intended function and not create a hazard to the aircraft or its occupants. Controls, labeling, use of colors, symbology, behavior, responsiveness, and map features should follow the guidance in RTCA/DO-257A and may need to be evaluated for operational suitability by the TTCAA. Any additional intended functions displaying own-ship position, which are limited to airport surface operations only and a minor failure condition classification, should address performance standards established for those functions and perform its intended function so as to not create hazard to the aircraft or its occupants.

(3) **Directionality.** Change own-ship to a non-directional (circular) depiction when heading is not available or cannot be calculated based on GNSS data.

(4) **GNSS Data Stream.** Remove own-ship if the GNSS data stream stops. This guards against a “frozen” own-ship condition caused by position source signal loss with the EFB, or the GNSS device losing charge/power source. Design the EFB system to monitor the GNSS data stream health for a regular stream of position updates (e.g., every second for systems updating at 1 Hz). Remove own-ship if the GNSS position doesn’t update as expected for three consecutive update cycles (e.g., three seconds for systems updating 1 Hz).

(5) **GNSS Accuracy.** Remove own-ship if GNSS source is indicating accuracy exceeding its part of the maximum allocation (e.g., for systems utilizing a total error budget of 40 meters, with 25 meters being allocated to database error, the maximum allocation for position source accuracy would be 15 meters).

(6) **Map Zoom.** Design the application to include a maximum zoom limitation to help visually constrain and highlight the display of own-ship position is insufficient to directly support maneuvering. The level of zoom should be limited to providing supplemental position awareness only. Ensure the range of display zoom level is compatible with the position accuracy of the own-ship symbol.

(7) **Visual Check Training.** Crewmember training, to use display of own-ship position on the airport surface, should include visual check procedures to require the pilot to do visual checks of outside airport signage and markings against the depicted airport map to verify the own-ship symbol is shown at that same location. Training should also include proper error reporting procedures for crewmembers when visual checks reveal display discrepancies.

g) **Responsiveness of Application.** The system should provide feedback to the user when user input is accepted. If the system is busy for an atypical time 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.

h) **Offscreen 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 offscreen content should be clearly indicated in a consistent way. For some intended functions, it may be unacceptable if certain portions of documents are not visible. The basis of this evaluation should be on the application and intended operational function. If there is a cursor, it should be visible on the screen at all times while in use. The default position should be easily accessible after any active manipulation (e.g., zooming, panning, or decluttering).

i) **Active Regions.** Active regions are regions to which special user commands apply. The active region can be text, a graphic image, a window, a frame, or another document object. If the display uses active regions, these regions should be clearly indicated.

j) **Managing Multiple Open Applications and Documents.** The electronic document application should provide continuous indication of which application and/or document is active if the system supports multiple open documents, or if the system allows multiple open applications. The active document is the one that is currently displayed and responds to user actions. Under non-emergency, normal operations, the user should be able to select which of the open applications or documents is currently active. In addition, the user should be able to find which open flight deck applications are running and switch to any one of these open 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.

k) **Input Devices.** All controls must be within reach of the appropriate crewmember seated normally on the flight deck. In choosing and designing input devices such as keyboards or cursor-control devices, operators should consider the type of entry to be made and flight deck environmental factors, such as turbulence and other normal vibrations that could affect the usability of that input device. Typically, the performance parameters of cursor-control devices are tailored for the intended application function as well as for the flight deck environment. Input devices should provide feedback to indicate when operational.

l) **Flight crew Workload.** The EFB software design should minimize flight crew workload and head-down time. The positioning, use, and stowage of the EFB should not result in unacceptable flight crew workload. Avoid complex, multi-step data entry tasks during 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. If the intended function of an EFB includes use during critical phases of flight, such as during takeoff, landing, or abnormal and emergency operations, its use should be evaluated during simulated or actual aircraft operations under those conditions.

m) **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 nonessential applications such as email connectivity and administrative reports may require an error message when the user actually attempts to access the function, rather than an immediate status annunciation when a failure occurs. EFB status and fault messages should be prioritized and the message prioritization scheme evaluated and documented.

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

o) **Error and Failure Modes.**

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

(2) **Identifying Failure Modes.** The possible effects of undetected errors in each EFB application should be evaluated. The assessment should address the adequacy of the human machine interface, accessibility of controls, ability to view controls, annunciations, displays and printers, and the effect on flight crew workload and head-down time. The assessment should also consider the effects of flight crew (procedural) errors determined by comments from the professional pilot community. The system should be capable of alerting the flight crew of probable EFB application/system failures.

p) **Integrity Considerations.** The operator must demonstrate that the EFB performs its intended functions. Additionally, data contained in the data files should be of sufficient integrity to perform the intended functions without producing false or hazardously misleading information. A process for continuous fault or anomaly reporting by the users is essential to an effective EFB program. This is initially accomplished through the evaluation process and the validation period. It is subsequently maintained through data updates and software revision procedures.

APPROVAL PROCESS

23. The introduction and use of EFBs in the cockpit/flight deck and cabin require authorization from the TTCAA. This requirement includes evaluation of all operating procedures, pertinent training modules, checklists, operations manuals, training manuals, maintenance programs, minimum equipment lists (MEL), other pertinent documents, and reporting procedures.

a) **General Process for Approval.** Electronic Flight Bag Authorization is accomplished by administration of a five-phase process and consists of the following five phases:

(1) **Phase 1** of the process begins when an operator requests authorization from the TTCAA. The TTCAA and the operator should reach a common understanding of what the operator must do, what role the TTAA will have, and what reports and documents will be included as part of the authorization process.

(2) **Phase 2** begins when the operator submits a plan to the TTCAA for formal evaluation. During this phase, the TTCAA must ensure that the plan is complete and in an acceptable format before it can conduct a thorough review and analysis. The operator coordinates the plan with the TTCAA Project Manager (PM) or other inspectors, as assigned. The PM or other assigned inspectors will facilitate coordination with other external advisory agencies, if necessary. The operator must submit the following information in the application package:

- EFB hardware and application specification,
- EFB operator procedures/manual revisions,
- EFB cockpit procedures checklists,
- EFB training program,
- EFB evaluation report **(APPENDIX 3 – ELECTRONIC FLIGHT BAG EVALUATION and APPENDIX 4 - ELECTRONIC FLIGHT BAG OPERATIONAL EVALUATION)**,
- RD test data (when required),
- Completed non-interference test results, and
- Airworthiness documents for Class 2 equipment (mounting device, aircraft data connection, aircraft power primary, and remote antenna).

(3) **Phase 3** begins when the TTAA starts its in-depth review and analysis of the operator's plan for regulatory compliance, safe operating procedures, logical sequence, and other areas (e.g., flight crew and dispatcher qualifications, acceptable procedures, and schedules for accomplishment). Additional simulator/flight evaluations are not required for adding a new EFB to an existing authorization unless there is a substantial change in EFB intended functions. When a new aircraft is added to a certificate with existing EFB authorization, the suitability of the EFB for the aircraft must be addressed as part of aircraft conformity and configuration control process.

(4) **Phase 4** is the major phase of the process and involves validation testing. In this phase, the operator conducts specific operations for the purpose of data collection or for TTCAA observation purposes. During validation testing, the certificate operator must maintain a paper back up of electronic information as well as Navigation charts specified in its OpSpec. Phase 4 concludes when the operator provides sufficient proof to satisfy the TTCAA's requirement for meeting all the plan objectives or when the operator is unable to complete them satisfactorily. For tracking and standardization purposes, the TTCAA will temporarily issue the certificate holder/operator/ OpSpec/A061. The "Restrictions and Limitations" column in **TABLE 1** of A061 should include the remark "Temporary Authorization to conduct 6-month operational validation testing." **APPENDIX 5** and **APPENDIX 6** depict examples of the relevant OpSpec section for EFB approval.

(5) **Phase 5** begins after the successful completion (or termination) of the validation phase. In this phase, the TTCAA grants authorization for those elements in the validation plan that were successfully completed and documented, or sends the operator a letter of disapproval for those elements that were not completed or that were terminated. The PM makes the necessary recommendation to the Director General for grant of authorization for the operational use of the EFB through the issuance of OpSpec A061, Use of Electronic Flight Bag.

b) **Operator Responsibilities.** In addition to accomplishing the required testing of EFB equipment to obtain authorization for EFB use, the following steps (in chronological order) are suggested:

1) For certificate holders, make written application in a form and manner acceptable to the TTCAA.

2) Demonstrate a fault and anomaly reporting process to ensure initial and continuing reliability for each EFB.

3) Demonstrate that the radio magnetic interference/EMI tests have been performed satisfactorily.

4) Demonstrate that any electronic receptacles used for connection of the EFB to an aircraft system have been installed using TTCAA-approved procedures.

5) Demonstrate that the EFBs can be properly stowed, secured, and/or mounted in the aircraft.

6) Demonstrate that successful rapid decompression testing has been accomplished, if applicable.

7) Develop policies and procedures that may include, but are not limited to, the following:
   - For single-pilot and multi crew-flown aircraft, appropriate procedures for EFB use during all phases of flight;
   - Procedures to follow when one unit fails (where multiple units are carried onboard the aircraft);
   - Procedures to follow when all units fail (the procedures should specifically identify alternate means for obtaining data);
   - A revision process procedure/method that ensures appropriate database accuracy and currency;
   - Courseware to be used while conducting training;
   - Procedures that document the knowledge of the user (e.g., training received, evaluation forms, test results);

- A list of the software and data loaded and maintained in each unit; and

- Instructions for continued airworthiness in accordance with the manufacturer's Recommendations (also include these instructions in the inspection/maintenance program).

8) Operators transitioning to a paperless or reduced-paper cockpit should carry paper backups, as specified in the current OpSpecs and/or Operations Manual, of all the information on the EFB during a validation period. The backup information should be readily available to the crew. During this period, the operator should validate that the EFB is as available and reliable as the paper-based system being replaced.

9) For certificate holders, this validation period should include a 6-month operational test evaluation where the EFB system(s) will be available to the crew with all appropriate backup products. The backup products and the EFB are not used simultaneously during the evaluation period, but the backup products are available if needed. Reductions to the required EFB 6-month operational validation testing may be considered if the certificate holder has previous experience with EFBs. A request to reduce the 6-month operational validation testing requires approval from the TTCAA. The certificate holder must submit a plan, with justification to reduce the 6-month operational validation evaluation period, to the PM.

10) The operator will issue a final report detailing the training effectiveness, operational effectiveness, and reliability of the EFB.

c) **Operational Procedures Development.**

1) **EFB Intended Function.** The intended function(s) of EFBs may vary depending on the device used and the software applications hosted by the computer. It is extremely important that the operator specifically define the intended EFB functions in a clear and concise manner. Operational procedures developed to achieve a specific intended function or use should consider the applications listed in the attached appendices.

2) **Operator Responsibilities.** Operators will be expected to:

(a) Have procedures that define expectations of how the flight crew should use each EFB function during ground operations and under all flight conditions;

(b) Provide the procedures to flight crews;

(c) Provide procedures for normal, abnormal, and emergency use; and

(d) Review and determine whether to modify those existing policies and procedures affected by the introduction of EFBs into line operations.

3) **Procedural Considerations.**

a) **Procedures for Using EFBs with Other Flight Deck Systems.** Flight crew procedures will ensure that the flight crew knows what aircraft system to use for a given purpose, especially when both the aircraft and EFB are providing similar information. Procedures should also be designed to define the actions to be taken when information provided by an EFB does not agree with that from other flight deck sources or when one EFB disagrees with another. If an EFB simultaneously displays information that an existing cockpit automation displays, procedures to identify which information source will be primary and which source will be secondary need to be developed (as well as procedures to identify under what conditions to use the backup source). Whenever possible and without compromising innovation in design and use, EFB/user interfaces should be consistent (but not necessarily identical) with the flight deck design philosophy.

b) **Flight crew Awareness of EFB Software/Database Revisions.** The operator should have a procedure in place to allow flight crews to confirm the revision numbers and/or dates of EFB flight databases and software installed on their units for each flight. (Databases that do not adversely affect flight operations such as maintenance log forms, a list of airport codes, or a captain's atlas, for example, do not require the confirmation of revision dates by flight crews.) An example of a date-sensitive revision is an aeronautical chart database on a 28-day revision cycle. Procedures should specify what action to take if the applications or databases loaded on an EFB are out-of-date.

c) **Procedures to Mitigate and/or Control Workload.** Procedures that mitigate and/or control additional workloads created by using an EFB will need to be addressed.

d) **Defining Responsibilities for Performance Calculations.** The operator should develop procedures that define any new roles that the flight crew and dispatch may have in creating, reviewing, and using performance calculations supported by EFBs.

e) **Shutdown Procedures.** Shutdown procedures for EFBs should:

- Be incorporated into normal flight crew shutdown checklist procedures.
- Allow the EFB operating system and hosted applications to remain stable after multiple startups and shutdowns.

d) **EFB Configuration Control.** The operator's EFB specification documents must list the make and model of the authorized EFB equipment and include at least the following configuration information, which is also required to support OpSpec A061:

(1) Operating system to include version control;

(2) Application program version control;

(3) Approved source for the database updates;

(4) Make and model of EFB hardware (see note below); and

(5) Make and model of the EFB hardware, including a tracking process for major internal subcomponents whose replacement/upgrade may necessitate additional noninterference testing.

NOTE: *Permanently sealed tablet computing devices that have no interchangeable internal parts are tracked by make and model or part number of the device hardware itself (e.g., Make: Apple/iPad Air 2/Model: A1396).*

e) **Mitigation Strategy.** During the transition period to a paperless cockpit, an operator will need to establish a reliable backup means of providing the flight crew with the information required by the regulations. During this period, an EFB must demonstrate that it produces records that are as available and reliable as those provided by the current paper information system. Operators should establish procedural mitigations to provide a reliable means of displaying information that is required by the operating rules to the flight crew. This will ensure an equivalent level of safety and integrity to that of the current paper-based products. Mitigation may be accomplished by a combination of the following:

(1) System design;

(2) Separate and backup power sources;

(3) Redundant EFB applications hosted on different EFB platforms;

(4) Paper products accessible for use by crewmembers; and/or

(5) Procedural means.

f) **Procedural Mitigations.** If one or more onboard EFBs fail, resulting in loss of function or the presentation of false or hazardously misleading information, a contingency plan or process will need to be in place to provide the required information. For example, as a backup to eliminating printed approach charts, an acceptable transition to a paperless cockpit could include the following:

- Carrying paper products for a given time period to validate EFB reliability by quantitative means;
- Using a printing device to print all applicable data required for the flight; or
- Using an aircraft fax machine to uplink equivalent paper documents to the cockpit.

g) **Removal of Paper-Based Information.** The risk mitigation process must be completed prior to removal of the paper-based information associated with a particular EFB application. These

requirements also apply to an operator who intends to begin operation of any aircraft type without paper-based information.

h) **Database Update Process.**

(1) The operator needs to establish a method for revising EFB databases. The method of data revision should ensure integrity of the data that the operator loads and not negatively impact the integrity of the EFB operation. Especially when using Internet and/or wireless means, procedures must exist to protect the EFB data from corruption. Database revisions do not include application software or operating system changes. Application software and/or operating system program changes must be controlled and tested prior to use in flight. Operators should not perform database and/or application software changes during operations (taxi, takeoff, in-flight, and landing).

(2) Operators also need to establish revision control procedures so that flight crews and others can ensure that the contents of the database are current and complete. These revision control procedures may be similar to the revision control procedures used for paper or other storage media. For data that is subject to a revision cycle control process, it should be readily evident to the user which revision cycle is currently loaded into the EFB.

i) **Software Revision Process.**

(1) It is the responsibility of the operator and/or the application software vendor to ensure that its operating system and Type A and Type B application programs meet the intended function. Unauthorized modification of any database, or the loading of any new or additional software intended for operational use is not permitted unless that software can be demonstrated to comply with the original intended use. In addition to the operator's responsibilities described above, it is the responsibility of the pilot in command (PIC) to verify that any EFB depiction of an en route, terminal area, approach, airport map, or sectional is current and up-to-date. One means for doing this is to ensure that each PIC becomes familiar with all available information concerning that flight, to include receipt of appropriate Notices to Airmen (NOTAM) prior to departure and prior to arrival.

(2) The operator should identify a means to demonstrate that adequate security measures are in place to prevent malicious introduction of unauthorized modifications to the EFB's operating system, its specific hosted applications, and any of the databases or data links used to enable its hosted applications (i.e., security risk assessment). The operator also needs to protect the EFB from possible contamination from external viruses.

j) **Special Data Storage and Retrieval Considerations.**

(1) The EFB needs to permit any authorized representative of the AIA [Accident Investigation Authority] to retrieve, view, or print the information contained in any EFB upon receipt of a reasonable request. If the TTCAA or the AIA require an operator to provide information, the operator must provide the data in a format that the requesting agency can use.

(2) Operators should establish procedures to archive or retain old data. For archived data, the length of time that the data is kept depends on the kind of information being archived. Some information, such as maintenance historical data, should be kept for the life of the aircraft. It may also be necessary to keep old versions of software and operating systems to properly retrieve archived data. Operators should download maintenance discrepancy logs into a permanent record at least weekly.

k) **Training.** Training should reflect the level of the functionality and complexity as agreed upon by the operator and the TTCAA. Training should address flight crew, flight operations officers, and maintenance personnel requirements, as appropriate.

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

(a) A description of the EFB, its capabilities, and the applications for which the operator will use the EFB and its components and peripherals. This should include theory of operation, and the training should ensure that flight crews understand the dependencies associated with the sources and limitations of the information.

(b) A description of EFB controls, displays, symbology, and failure modes. EFB failure modes and flight crew procedures should include a description of the EFB (e.g., EFB processor, switches, and installed databases, such as an airport surface or en route moving map). If color is a significant EFB application feature, then training materials should include color illustrations.

(c) An AFMS or another form of documentation that provides conditions, limitations, and procedures for the use of the EFB and its associated equipment. For instance, operators should train flight crews on how to ensure that the airport charts and manuals are current, and what to do if they find that the software and/or databases are out-of-date. Only EFB provisions (mounts, wiring, etc.) for Class 2 EFBs or installation for Class 3 EFBs require an AFMS, unless approved by a TSO. Class 1 and Class 2 EFBs and Type A and Type B EFB applications may require an alternative means of documentation that provides conditions, limitations, and procedures for use.

(d) Descriptions of authorized special flight manoeuvres, operations, and procedures that the operator conducts when using an EFB.

(e) Any special pilot/controller procedures when using EFB-based information.

(f) Geographical areas authorized for specific EFB operations, if applicable.

(g) Authorized methods to defer inoperative EFB equipment.

2) Operator training should also provide an opportunity for instruction, demonstration, and practice using the actual or simulated EFB equipment and displays. Base the EFB qualification curriculum segment on functionality and complexity as agreed upon by the operator and the PM. In addition, EFB components installed in accordance with applicable airworthiness regulations may contain EFB training guidance.

3) AOC operators are required to conduct initial fleet training. After the PM evaluates the operator's EFB curriculum segment and determines that it is satisfactory, the PM issues an interim authorization to the operator. This authorizes the operator to continue training in accordance with the operator's approved training program.

l) **Pilot Training Program.** All flight crew may need to complete an approved training program before being authorized to use the EFB equipment. However, flight crew members should have satisfactorily completed the ground school portion of the EFB training program, if required. Training as outlined in this TAC is only applicable to those flight crew members that actually operate the equipment. Training is not required of crewmembers that are not authorized to use the equipment, even though it may be installed in the aircraft, unless it is operated under the supervision of a check pilot. For air carrier operations, initial qualification with the EFB may require that the flight crew members demonstrate satisfactory proficiency with the EFB to an TTCAA inspector or check pilot; this may be completed during a line check.

m) **Simulator and Flight Evaluations.**

1) **Simulator Evaluations.** Simulators and other approved training devices (e.g., procedures trainers) may be used as a tool to evaluate the overall quality of the training given and/or to evaluate EFB performance before granting authorization for use. The level of simulation fidelity required depends upon the type of use/credit being sought. Some of the EFB characteristics and flight deck integration issues that should be evaluated via simulation include:

- The flight crew's use of displays;
- EFB control use;
- Alert reactions;
- Auto-ranging configuration;
- Self-tests;
- Flight crew procedures; and
- Failure mode analysis.

2) **Flight Evaluations.**

a) Base the number of flight evaluations required to validate a particular EFB before authorizing its use (including its hosted applications) on:

- Type of aircraft;
- Aircraft system architecture;
- Flight crew workload considerations;
- Credit given for previously certified installations; and
- Past simulator and ground testing.

b) The PM will determine if an approved training device or an actual flight evaluation is required. If adequate evaluation of changes in the EFB, including software upgrades, is not possible on the ground or in simulators, it may require flight-testing.

n) **Need for Approved Manuals.** Need for Approved Manuals. The aircraft must carry a TTCAA-approved AFM/RFM onboard at all times when the EFB equipment is installed in accordance with applicable airworthiness regulations. These manuals can be in an electronic format provided the operator has paperless authorization for the AFM and/or company manual.

o) **Continued Airworthiness.**

(1) Although a source independent of the operator may provide ongoing maintenance and support for EFB equipment, the operator is responsible for compliance with all regulatory requirements.

(2) The maintenance or inspection program should identify inspection items, establish time-in-service intervals for maintenance and inspections, and provide the details of the proposed methods and procedures. The maintenance or inspection program should also include Instructions for continued airworthiness for the STC or state of design or installation approval.

(3) It is important for operators to coordinate with their PM on airworthiness-related considerations early in the process to determine the appropriate authorizations necessary for each EFB application.

p) **MELs.** Operators may update their MELs to reflect the installation of this equipment. Changes made to the operator's MEL should be made in accordance with the approved Master Minimum Equipment List (MMEL).

q) **EFB Substitution/Use in More Than One Aircraft.** The operator may substitute compatible EFBs for use in other aircraft. Specific procedures are necessary to ensure that an EFB is fully compatible with other aircraft and their systems prior to placement into service. It is also

necessary to develop procedures to ensure that any aircraft-specific data captured in EFB memory is archived for that aircraft when the EFB moves to another aircraft.

r) **User Feedback.** Operators should implement a formal process for gathering feedback. Use this process during design, installation, modifications, or improvements to procedures and/or training.

s) **Paperless Authorization.**

1) **Certificated Operators.** The issuance of OpSpec A061 gives operational authorization for an air carrier or commercial operator who intends to use EFBs for flight operations. It may be necessary to issue or amend other OpSpecs, as appropriate. The OpSpec must reference the company documents, records, or manuals presented with the operator's application.

2) EFBs used in lieu of paper reference material are authorized for the intended functions provided the EFBs meet the criteria set forth in this TAC. The evaluation and suitability for in-flight use of an EFB in lieu of paper reference material is the responsibility of the aircraft operator and the PIC. Any Type A or Type B EFB application, as defined in this TAC, may be substituted for the paper equivalent. It requires no formal operational approval as long as the guidelines of this TAC are followed.

(a) Any Type A or Type B EFB application, as defined in this TAC, may be a substitute for the paper equivalent. When the EFB replaces aeronautical information required by TTCAR 2:9 (76A), then a secondary or backup source of aeronautical information necessary for the flight must be available to the pilot in the aircraft. The secondary or backup information may be either traditional paper-based material or displayed electronically by other means.

(b) The aircraft operator and/or PIC are responsible for showing compliance with all the requirements of subparagraph "**22.** c)" in this TAC. This should be in written form onboard the aircraft. The EFB system onboard must be functionally equivalent to the paper reference material which the information is replacing. The pilot verifies that all information used for navigation, aircraft operation, or performance planning is current, up-to-date, and valid.

(c) The aircraft operator and/or PIC is responsible for making an assessment of the human/machine interface and aspects governing Crew Resource Management (CRM) in accordance with the human factors considerations of this TAC. This requires training in EFB procedures and use, preflight checks of the system, the use of each operational function on the EFB, and procedures for cross-checking data entry and computed information. Also, included in this training, are the conditions (including phases of flight) when EFB use should be terminated.

t) Electronic Authorization. Final authorization for use of electronic documents, in lieu of required paper documents, requires:

(1) Operational evaluation completion, including the validation report;

(2) Reliable EFB information available for each flight crew member;

(3) EFB maintenance and fault reporting procedures in place;

(4) Noninterference testing as specified in paragraph **18.** of this TAC;

(5) Results from rapid decompression testing and related mitigating procedures when the EFB system hosts applications that are required to be used during flight following a rapid decompression; and

(6) OpSpec A061 authorization, as appropriate.

APPENDIX 1 - GUIDANCE OF INSTALLED EFB COMPONENTS

1. Mounting Device. This section applies to mounting devices intended to hold EFB equipment. The design of the FB display mounting devices must address applicable airworthiness regulations. EFB mounting devices (or other securing mechanism) may include arm-mounted, cradle, yoke mounts or clips, or docking-stations. Positioning must not obstruct visual or physical access to aircraft controls and displays, flight crew ingress or egress, or external vision. Consider the following design practices for installation:

1) **Accessibility.** 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 and must not compromise the intended function of other installed equipment. If the EFB display is installed, the display must be easily viewed and the controls easily reached without requiring major adjustments to body position.

2) **Locking.** Adjustable mounting devices should be able to lock in position easily. When designing locking positions, accommodate the expected range of users' sizes and physical abilities (e.g., anthropometric constraints). Locking mechanisms should be of the low-wear type, which minimizes slippage after extended periods of normal use.

3) **Crashworthiness.** The design must address applicable crashworthiness certification and regulations. This includes the appropriate restraint of any device, when in use or in designated stowage mounts.

4) **Yoke Mounts and Clips**. Applicants and operators should be aware of unsafe conditions potentially created when attaching a portable EFB component to the control yoke with an attachment mechanism, mounting device, or clip. For example, the weight of both the EFB and mounting bracket may affect flight control system dynamics or warning indications, such as aerodynamic disturbances or from artificial stall-warning devices (e.g., stick shaker); even though the mount alone may be light enough to be insignificant. The mass, moment of inertia, as well as the physical size of the combined mount and EFB, can all contribute to potential unsafe conditions which may require design changes to flight controls and additional flight testing upon installation. Yoke mounting of an EFB is *not recommended* and all the yoke mounting components (e.g., mounts, brackets, clips, etc.) for the EFB must be incorporated into the aircraft type design. When the EFB mounting device is not intended for a specific EFB model, document the demonstrated performance parameters for the mounting device (e.g., weight parameters) in the airplane or rotorcraft flight manual (AFM/RFM), airplane or rotorcraft flight manual supplement, operating manual, or instructions for continued airworthiness, as appropriate.

5) **Use of Hook-and-Loop Fasteners**. We *do not recommend* use of hook-and-loop fasteners, such as Velcro, for mounting or securing EFB components to a mount, or the aircraft, because the closure strength of hook-and-loop fasteners degrades with each use. The cycle life, which is the number of times the hooks and loops can be engaged and disengaged before the closure strength is reduced to 50% of original values, cannot be accurately tracked without a maintenance action. However, if using hook-and-loop fasteners for installed EFB mounts to ensure crashworthiness:

(a) The instructions for continued airworthiness must identify inspection intervals, inspection process, and replacement intervals to ensure the installed hook-and-loop fastener material is able to perform its intended function (e.g., retain a portable EFB component of specific size and weight) when the hook-and-loop fastener material has reached its maximum inspection interval.

(b) Document the procedure for properly fastening the hook-and-loop fasteners to restrain a portable EFB component.

Note: *The use of a label or placard may be appropriate to address proper fastening of the hook-and-loop fasteners.*

2. Power Provisions. This section applies to design considerations for installing dedicated power port and cabling provisions for portable EFB components. Installed EFB power provisions must address applicable airworthiness regulations. Design EFB power provisions to include:

(1) **Installed Switch.** A means, reachable by the pilot seated at the controls, should be provided for de-powering the EFB or power port (e.g., access to unplug the EFB, or a separate switch clearly labeled for the power port). The use of a circuit breaker as a means of de-powering a function is *not* acceptable, unless designed to be a switch, since the repeated use of circuit breakers as switches can degrade their performance and prevent them from actuating at the rated current trip point.

(2) **Fault Protection.** An appropriate means of fault protection (e.g., circuit breaker) for the power port circuit should be provided. Ensure the circuit protective device requirements guard against inadvertent contact with energized parts of the system. If a fault is detected, the power port should be automatically deactivated. Automatic reset features should *not* be permitted.

(3) **Power Source.** Connect EFB power provisions to a non-essential or the least critical power bus so failure or malfunction of the device, or power supply, will not affect safe operation of critical or essential systems. Connection to more critical aircraft power buses is permitted if the intended function of the EFB warrants.

(4) **Port Labeling.** Labeling of aircraft power ports should be provided to identify the electrical characteristics (e.g., 28 VDC, 115 VAC, 60 or 400 Hz, etc.) in order to address equipment sensitivity to voltage, current, or frequency parameters and to provide awareness to the flight crew or maintenance personnel, reducing the likelihood of connecting incompatible devices to the power source. Given the variety of outlet and connector types used for various power sources and the variety of plug adapters available, outlet type alone is not considered to be sufficient. The labeling placard must be legible, easy to see, and as close as practicable to the power port. The labeling placard should not impose any limitations on the portable EFB component itself, which is the operator's responsibility.

(5) **Mount Cabling.** If cabling is installed to mate aircraft systems with an EFB, the cable should not hang loosely and provisions should be made to easily secure any exposed cables out of

the way during aircraft operations (e.g., cable tether straps). Cables external to the mount should be of sufficient length to perform the intended tasks. Cables too long or short must not present an operational or safety hazard.

3. Data Connectivity. Data Connectivity with Aircraft Systems (Wired or Wireless). This section applies to interfacing with portable and installed EFBs. Typically, installed EFBs will have the interface protection built into the installed EFB component, while portable EFB components must have a separate data connectivity provision installed in the aircraft. All EFBs using data connectivity provisions to aircraft systems must incorporate an interface protection device (e.g., physical partitioning, read-only access, etc.) to ensure data connection required by the device, and its software applications, have no adverse effects on other aircraft systems, including installed antennas, installed data servers, data storage devices, and memory. EFBs having data connectivity to aircraft systems; either wired or wireless, may read or transmit data to and from aircraft systems, provided the connection and interface protection device is incorporated into the aircraft type design. This connectivity includes data bus and communication systems access (e.g., through an avionics data bus, server, network interface device, or wireless network). Use the following guidance for read-only and transmit-receive data interface protection devices:

1) **Read-only Access.** The design of interface protection devices providing read-only access must ensure protection by using one-way communication of data.

2) **Transmit-Receive Access.** The design of interface protection devices providing transmit (talk) and receive (read) capability must include:

(a) **Partition.** The design must provide a means to partition applications which are not installed from installed systems on the aircraft.

(b) **Non-Interference.** The design must include a means to ensure EFB operation, malfunction, or failure does not adversely affect safe and continued operation of other installed aircraft systems to which connection is made. Design interface protection devices enabling connection of EFBs to existing aircraft equipment, systems, memory, data storage, data buses, or networks to address any likely vulnerability and threats in terms of computer viruses, worms, unauthorized access, and malicious access.

4. Display. This section provides design guidance for the installation of EFB displays, including installation of shared displays, supporting both portable EFBs and installed systems.

(1) **Placement.** Placement for EFB displays need to consider many factors: accessibility, workload effects, and potential pilot fatigue effects from use, etc. Pilot compartment view considerations include glare, reflection, and visual field. Applicants may develop equivalent level of safety (ELOS) justifications for alternative means of compliance, provided they are formally requested and agreed to by the TTCAA in advance. Analysis, simulation, and demonstration of previously completed ground, flight testing, or service history on a similar platform may be considered when developing an alternative means of compliance. Portable displays should also be evaluated for external vision considerations with the intended EFB.

(2) **Screen Size and Resolution.** When utilizing the EFB to replace paper products, the screen size and resolution should be designed to display information in a comparable manner to paper aeronautical charts and the data it is intended to replace. For example, the screen should be able to display a standard instrument approach procedure (IAP) chart in an acceptable aeronautical chart format similar to a published paper chart. The screen should be large enough to show the entire IAP chart at once, with the equivalent degree of legibility and clarity as a paper chart. This is not meant to preclude panning and zooming features, but is intended to prevent a workload increase during the approach phase of flight.

(3) **Recommended Display Standards.** Installed EFB displays are multipurpose display devices and we recommend use of the design standards found in Society of Automotive Engineers (SAE) Aerospace Standard (AS) 8034B, Minimum Performance Standard for Airborne Multipurpose Electronic Displays.

5. Processor and Partitioning. Installed EFBs may be packaged in various configurations, including a single processor, or a partitioned architecture with multiple operating systems (OS) and multiple processors. Partitioning for installed EFBs should be done via means enforcing controlled access to system resources (e.g., memory, processors, I/O, mass storage, etc). One means to partition an EFB is to create two physically separate systems feeding into a common installed display with a commercial-off-the-shelf (COTS) processor and OS hosting EFB Type A/B applications, and a certified processor and OS environment for approved software applications. These Type A/B applications are typically considered as "hosted" because they have no requirement to be installed as part of aircraft type design or as an alteration. In this instance, both environments may reside in the same equipment and feed into a common display device with a certified integration capability between the separate environments to integrate display of application data. Other means of partitioning may be acceptable; however, partitioning must guarantee required throughput and resources (memory, hard drive, avionics data, etc.) for approved applications. Specifically, the design must ensure Type A/B applications have no adverse effect on the safe and continued operation of approved software and other aircraft systems. EFB configurations include:

(1) **EFBs Hosting Only Type A/B Applications.** Installed EFBs may be designed with the intent to host only EFB Type A/B applications. Such equipment would usually identify the hardware installed as miscellaneous, nonrequired equipment. The host environment OS and Type A/B applications are not installed, and may be loaded by the manufacturer or operator.

(2) **EFBs Hosting Type A/B Applications and Approved Software.** Installed EFBs may be designed with the ability to host EFB Type A/B applications and approved software as part of aircraft type design. Approved software applications are those found in avionics, including intended functions for communications, navigation, and surveillance requiring FAA design, production, and installation approval. This EFB configuration must include means of partitioning or protection to prevent the hosted Type A/B applications from having any adverse effects on the approved software and other aircraft systems.

(3) **Type A/B Applications Installed as Approved Software.** Historically, operators have used Type A/B applications on portable EFBs. However, it is acceptable to develop approved software to perform as Type A and B applications. For example, provided the intended function has been

evaluated specifically for replacement of paper products, software with an airworthiness approval performing an aeronautical charting application should require no further evaluation by the AEG to be authorized for use in an EFB.

6. Controls. In choosing and designing input devices for installed EFBs, such as keyboards or cursor control devices, designers should consider the type of entry to be made and flight deck environmental factors, such as turbulence and other normal vibrations, which could affect the usability of the input device.

7. Rechargeable Lithium Batteries. Rechargeable lithium batteries (typically lithium-ion and lithium-polymer (lithium-ion polymer)) have higher energy levels than previous rechargeable batteries and also have higher flammability potential, so it is important to take precautions in their use. If mistreated, or not manufactured and maintained to industry safety standards, rechargeable lithium batteries can become hazardous. Installed EFBs employing rechargeable lithium batteries must ensure the lithium ion batteries meet airworthiness standards appropriate for the battery size and intended function. The use of rechargeable lithium batteries in portable devices is the responsibility of the operator.

8. Guidance Applicable to All Installed Components.

a) **Airborne Electronic Hardware.** This TAC does not cover installed EFB components, including complex custom Airborne Electronic Hardware, with failure condition classification that is major. If the failure condition classification is minor, or no effect, an existing design assurance practice may be used to develop the complex custom Airborne Electronic Hardware.

b) **Environmental Qualification.** Ensure the environmental qualification of installed EFB components is appropriate for the installation. We recommend utilizing RTCA/DO-160 Versions D, E, F, and G, "Environmental Conditions and Test Procedures for Airborne Equipment," to demonstrate equipment performance in environmental conditions encountered during operation of the EFB components in aircraft.

c) **Lightning Protection.** Ensure installed EFB components meet appropriate lightning requirements. For further guidelines refer to FAA AC 20-136, Aircraft Electrical And Electronic System Lightning Protection, to demonstrate appropriate lightning protection.

d) **High Intensity Radiated Fields.** Ensure installed EFB components meet the appropriate High Intensity Radiated Fields requirements. For further guidelines refer to FAA AC 20-158, The Certification of Aircraft Electrical and Electronic Systems for Operation In The High-Intensity Radiated Fields (HIRF) Environment, to demonstrate the equipment is protected when operating on an aircraft when the aircraft is exposed to an external HIRF environment.

e) **Software.** Ensure the design assurance level of installed software is consistent with the failure condition classification for the intended function. Develop approved software using RTCA, Inc., Document RTCA/DO-178B.

f) **Failure Condition Classifications.** Hazards associated with the malfunction of the EFB will depend not only on the EFB hardware, but also on the functionality of the installed software applications running on the EFB.

(1) Typically, the failure condition classification of Type A/B applications, as defined in this TAC, is considered to be minor or no effect and provides allowances for use of these applications on EFBs based on an equivalent level of safety to the paper reference material or operational process. When the Type A/B application is installed as part of aircraft type design or as an alteration, you may consider malfunction of the Type A/B application to be a minor failure condition classification and loss of the Type A/B application to have no safety effect, or you may accomplish a system safety assessment to determine the appropriate failure condition classification.

(2) If the EFB supports other applications, the failure classification will be driven by those other applications. If the EFB hosts Type A/B applications, adequate partitioning or protection must be provided to ensure the EFB Type A/B applications have no adverse effects on those other applications.

(3) If the installed EFB interfaces with other aircraft systems and equipment, then the minimum design assurance of the installed EFB must consider the impact of any EFB malfunctions on systems to which it is interfaced. Design of interface protection devices must mitigate the impact of any EFB malfunctions.

g) **Documentation.** Expected performance information for installed EFB components listed in this Appendix should be documented following current flight manual guidance, and be included in the instruction for continued airworthiness. For example, the components requiring this information include mounting devices (e.g., weight, size, adjustment parameters, and mounting procedures, etc.), power provisions (e.g., port labeling to identify the electrical characteristics (e.g., 28 VDC, 115 VAC, 60 or 400 Hz, etc.) of the power port, and operation of installed power switch, etc.), and data connectivity (e.g., available data provided via wired/wireless means, etc.).

APPENDIX 2 – RELATED READING MATERIAL

9. ARINC Documents.

- ARINC 424, Navigation System Data Base.
- ARINC 653, Avionics Application Software Standard Interface.
- ARINC 653P1-3, Avionics Application Software Interface, Part 1, Required Services.
- ARINC 653P2-1, Avionics Application Software Standard Interface, Part 2 – Extended Services.
- ARINC 653P3, Avionics Application Software Standard Interface, Part 3, Conformity Test Specification.
- ARINC 660, CNS/ATM Avionics, Functional Allocation and Recommended Architectures.
- ARINC 661-4, Cockpit Display System Interfaces to User System.
- ARINC 828-3, Electronic Flight Bag (EFB) Standard Interface.
- ARINC 834-2, Aircraft Data Interface Function (ADIF).
- ARINC 840-1, Electronic Flight Bag (EFB) Application Control Interface (ACI) Standard.

10. FAA Advisory Circulars.

- AC 00-62, Internet Communications of Aviation Weather and NOTAMs.
- AC 20-115, Radio Technical Commission for Aeronautics, Inc., Document RTCA/DO-178.
- AC 20-140, Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services (ATS).
- AC 20-152, RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware.
- AC 20-159, Obtaining Design and Production Approval of Airport Moving Map Display Applications Intended for Electronic Flight Bag Systems.
- AC 20-171, Alternatives to RTCA/DO-178B for Software in Airborne Systems and Equipment.
- AC 20-173, Installation of Electronic Flight Bag Components.
- AC 21-16, RTCA Document DO-160 versions D, E, F and G, Environmental Conditions and Test Procedures for Airborne Equipment.
- AC 21-40, Guide for Obtaining a Supplemental Type Certificate.
- AC 23.1309-1, System Safety Analysis and Assessment for Part 23 Airplanes.
- AC 23.1311-1, Installation of Electronic Display in Part 23 Airplanes.
- AC 25-11, Electronic Flight Deck Displays.
- AC 25-16, Electrical Fault and Fire Prevention and Protection.
- AC 25.773-1, Pilot Compartment View Design Considerations.
- AC 25.1523-1, Minimum Flight crew.
- AC 25.1581-1, Airplane Flight Manual.
- AC 27-1, Certification of Normal Category Rotorcraft.
- AC 29-2, Certification of Transport Category Rotorcraft.
- AC 91.21-1, Use of Portable Electronic Devices Aboard Aircraft.
- AC 91-78, Use of Class 1 or Class 2 Electronic Flight Bag (EFB).
- AC 120-64, Operational Use & Modification of Electronic Checklists.
- AC 120-71, Standard Operating Procedures for Flight Deck Crewmembers.
- AC 120-76, Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices.

11. FAA Orders and Policy Statements.

- Order 8110.4, Type Certification.
- Order 8150.1, Technical Standard Order Program.
- Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS).
- Order 8900.1, Flight Standards Information Management System (FSIMS).
- PS ANM100-01-03A, Factors to Consider when Reviewing an Applicant's Proposed Human Factors Methods of Compliance for Flight Deck Certification.
- PS ANM111-1999-99-2, Guidance for Reviewing Certification Plans to Address Human Factors for Certification of Transport Airplane Flight Decks.

12. FAA TSOs.

- TSO-C113, Airborne Multipurpose Electronic Displays.
- TSO-C165, Electronic Map Display Equipment for Graphical Depiction of Aircraft Position.

13. Miscellaneous Documents.

- UN ST/SG/AC.10/11/Rev.5, Recommendations on the Transport of Dangerous Goods-Manual of Tests and Criteria.
- UN ST/SG/AC.10/34/Add.2, Amendments to the Fourth Revised Edition of the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria.
- National Institute of Standards and Technology (NIST) Special Publication 800-30, Risk Management Guide for Information Technology Systems.

14. RTCA Documents.

- RTCA/DO-160, Environmental Conditions and Test Procedures for Airborne Equipment.
- RTCA, Software Considerations in Airborne Systems and Equipment Certification.
- RTCA/DO-199, Potential Interference to Aircraft Electronic Equipment From Devices Carried Aboard.
- RTCA/DO-200, Standards for Processing Aeronautical Data.
- RTCA/DO-201, Standards for Aeronautical Information.
- RTCA/DO-208, Minimum Operational Performance Standards for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS).
- RTCA/DO-233, Portable Electronic Devices Carried Onboard Aircraft.
- RTCA/DO-242, Minimum Aviation System Performance Standards for Automatic Dependent Surveillance Broadcast (ADS-B).
- RTCA/DO-249, Development and Implementation Planning Guide for Automatic Dependent Surveillance Broadcast (ADS-B) Applications.
- RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware.
- RTCA/DO-255, Requirements Specification for Avionics Computer Resource (ACR).
- RTCA/DO-257, Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps.
- RTCA, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B).

- RTCA/DO-264, Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications.
- RTCA/DO-267, Minimum Aviation System Performance Standards (MASPS) for Flight Information Service-Broadcast (FIS-B) Data Link.
- RTCA/DO-272, User Requirements for Aerodrome Mapping Information.
- RTCA/DO-276, User Requirements for Terrain and Obstacle Data.
- RTCA/DO-282, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast.
- RTCA/DO-294, Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDs) on Aircraft.
- RTCA/DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems.

15. SAE Documents.

- ARP4754A, Guidelines for Development of Civil Aircraft and Systems.
- ARP4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.
- ARP5289A, Electronic Aeronautical Symbols.
- ARP5621, Electronic Display of Aeronautical Information (Charts).
- AS 8034B, Minimum Performance Standard for Airborne Multipurpose Electronic Displays.

APPENDIX 3 – ELECTRONIC FLIGHT BAG EVALUATION

Type of Operation	Name of Operator
☐ Air Operator (Schedule) ☐ Air Operator (Charter) ☐ Helicopter Operations ☐ Other: SPECIFY IF OTHER IS TICKED	NAME OF OPERATOR

Aircraft Type	EFB Manufacturer / Make / Model	Type of Hardware			Type of Software		
Aircraft Type	Manufacturer / Make / Model	☐ Class 1	☐ Class 2	☐ Class 3	☐ Type A	☐ Type B	☐ Type C

ELECTRONIC FLIGHT BAG HARDWARE		YES	NO	N/A
1.	If the EFB is to be used outside of the flight deck, can the EFB display be read under direct sunlight	☐	☐	☐
2.	Is the display brightness and contrast adjustable?	☐	☐	☐
3.	Is the display brightness acceptable when it adjusts automatically?	☐	☐	☐
4.	Are there any display artifacts such as jagged lines impairing functionality?	☐	☐	☐
5.	Are controls labeled appropriately to describe their intended function?	☐	☐	☐
6.	Are buttons and labels visible and readable under all flight deck illumination conditions?	☐	☐	☐
7.	Can EFB inputs be made quickly and accurately in any operational environment?	☐	☐	☐
8.	Does the input device provide sufficient tactile feedback in all environmental conditions?	☐	☐	☐
9.	Are inadvertent or multiple activation of controls minimized?	☐	☐	☐
10.	Does the EFB start up in a predictable state?	☐	☐	☐
11.	Can the EFB be rebooted when power is cut to the EFB?	☐	☐	☐
12.	Does the EFB function correctly when rebooted?	☐	☐	☐
13.	Are all the EFB failure modes easy to see and identify?	☐	☐	☐
14.	Is the failure annunciation/message appropriate for the EFB function which failed?	☐	☐	☐
15.	Are EFB recovery means easy to remember and apply when the EFB fails?	☐	☐	☐

GENERAL USER INTERFACE		YES	NO	N/A
16.	Is the revision information and currency expiration date available and presented clearly?	☐	☐	☐
17.	Does the device respond immediately to user inputs?	☐	☐	☐
18.	Is the processing speed always appropriate for normal use?	☐	☐	☐
19.	Are appropriate busy or progress indicators displayed when processing is delayed?	☐	☐	☐
20.	Is the user interface, including functions and navigation, consistent throughout the EFB?	☐	☐	☐
21.	Is all information needed displayed and easily accessible? Is there any missing or difficult information to find	☐	☐	☐
22.	Are common actions and time-critical functions easy to access?	☐	☐	☐
23.	Are there standard ways to perform common actions?	☐	☐	☐
24.	Are the displays and controls used on the EFB similar across applications? Are a common set of controls and graphical elements used?	☐	☐	☐
25.	Can all colors be distinguished under the various lighting conditions?	☐	☐	☐
26.	Is color coding implemented with a secondary code such as shading or highlighting when used to display critical information?	☐	☐	☐
27.	Are the colors red and yellow used appropriately only for warnings and cautions?	☐	☐	☐
28.	Is the text easily readable?	☐	☐	☐
29.	Do the characters stand out against the display background?	☐	☐	☐
30.	Are upper case and italic text used infrequently?	☐	☐	☐

31.	Is text used in low-visibility conditions appropriate in size and easy to read?	☐	☐	☐
32.	Is it easy to zoom in on text or graphics when they are too small?	☐	☐	☐
33.	Is it obvious when information is out of view and can it easily be brought into view?	☐	☐	☐
34.	Is the spacing between characters appropriate?	☐	☐	☐
35.	Is the vertical spacing between lines appropriate?	☐	☐	☐
36.	Are icons and symbols legible?	☐	☐	☐
37.	Are icon and symbol functions obvious?	☐	☐	☐
38.	Are the icons and symbols distinguishable from one another?	☐	☐	☐
39.	Is each icon's meaning explained by a label or other means?	☐	☐	☐
40.	Are the EFB icons and symbols consistent with their paper equivalents?	☐	☐	☐
41.	Are alerts and reminders consistent across all applications?	☐	☐	☐
42.	Are alerts and reminders implemented so as not to distract?	☐	☐	☐
43.	Is there control over when, and whether, the audio or video is activated?	☐	☐	☐
44.	Is it easy to reset parameters to their default when they have been customized?	☐	☐	☐
45.	Is EFB customization controlled through an administrative control process?	☐	☐	☐

GENERAL SOFTWARE APPLICATION		**YES**	**NO**	**N/A**
46.	Can required information be found quickly and accurately within all applications?	☐	☐	☐
47.	Is the information within applications organized consistently?	☐	☐	☐
48.	Is information layout consistent with the paper equivalent?	☐	☐	☐
49.	Is the layout of information appropriate for all applications?	☐	☐	☐
50.	Is high priority information easy to read?	☐	☐	☐
51.	Is it easy to tell which application is currently open/active?	☐	☐	☐
52.	Is it easy to switch between applications?	☐	☐	☐
53.	Is extra acknowledgement required to open applications when not flight related?	☐	☐	☐
54.	Do all open applications function as intended on an individual basis?	☐	☐	☐
55.	Is access or links to related information appropriately supported?	☐	☐	☐
56.	Are similar types of information accessed in the same way?	☐	☐	☐
57.	Is it easy to return to the place where the user started from?	☐	☐	☐
58.	Is printing supported, and if so, is the hard copy usable?	☐	☐	☐
59.	Can a portion of a document be selected to be printed?	☐	☐	☐
60.	Can a print job be terminated immediately?	☐	☐	☐

ELECTRONIC DOCUMENTS (IF APPLICABLE)		**YES**	**NO**	**N/A**
61.	Is it easy to tell where one is in relation to the full document?	☐	☐	☐
62.	Is it easy to move between documents quickly?	☐	☐	☐
63.	Is it easy to tell what document is currently in view?	☐	☐	☐
64.	Is there a list of available documents to choose from?	☐	☐	☐
65.	Is the document search function appropriate?	☐	☐	☐
66.	Are tables, especially complex ones, readable and usable?	☐	☐	☐
67.	Are figures readable and usable?	☐	☐	☐
68.	Is there a way to pre-select specific charts for easy access during a particular flight?	☐	☐	☐

ELECTRONIC CHARTS (IF APPLICABLE)		**YES**	**NO**	**N/A**
69.	Is there more than one way to search for a chart?	☐	☐	☐
70.	Is it easy to access charts when a last-minute change is necessary?	☐	☐	☐

71.	If the chart application uses aircraft location to facilitate access to charts, is this function appropriate?	☐	☐	☐
72.	Is it easy to switch between a decluttered and normal display if decluttering is supported?	☐	☐	☐
73.	Is there a clear indication when any chart elements are suppressed?	☐	☐	☐

ELECTRONIC CHECKLISTS (IF APPLICABLE)		**YES**	**NO**	**N/A**
74.	Are normal checklists available in the appropriate order of use?	☐	☐	☐
75.	Can checklists be accessed individually for review or reference?	☐	☐	☐
76.	During abnormal conditions, are relevant checklists easy to access?	☐	☐	☐
77.	During abnormal conditions, does the device indicate which checklists and/or checklist items are required and which are optional?	☐	☐	☐
78.	Is it clear where to find all checklists, whether on the EFB or on paper?	☐	☐	☐
79.	Is the location of a paper document provided when it is referred to by the ECL?	☐	☐	☐
80.	Does each checklist have a constantly visible title distinct from other checklists?	☐	☐	☐
81.	Is it easy to select a checklist from a set of open checklists?	☐	☐	☐
82.	Is there a reminder to review incomplete items when closing an incomplete checklist?	☐	☐	☐
83.	Can an incomplete checklist be closed after acknowledging it is not complete?	☐	☐	☐
84.	Does the ECL discourage two or more checklists from being used simultaneously?	☐	☐	☐
85.	Is progress through the ECL clear?	☐	☐	☐
86.	It is easy to reset the ECL to start over again?	☐	☐	☐
87.	Does the checklist provide appropriate reminders for tasks requiring a delayed action?	☐	☐	☐
88.	Does the checklist clearly highlight decision branches?	☐	☐	☐
89.	Can you return to the checklist from links or related information in one step?	☐	☐	☐
90.	Is there an indicator of which item in the checklist you are working on?	☐	☐	☐
91.	Is the checklist's active item clearly indicated?	☐	☐	☐
92.	Can the status of an item be easily changed?	☐	☐	☐
93.	Does the next item automatically become active when the previous one is complete?	☐	☐	☐
94.	Can the current item be deferred without completing it?	☐	☐	☐
95.	Is it easy to view other items, even in a long checklist, without changing the active item?	☐	☐	☐
96.	Is it easy to move between items within a checklist?	☐	☐	☐
97.	Does the active item change to the next after an item is completed?	☐	☐	☐
98.	Is there a clear indication all items as well as the whole checklist are complete when finished?	☐	☐	☐

PERFORMANCE CALCULATIONS (IF APPLICABLE)		**YES**	**NO**	**N/A**
99.	Does the device identify entries having an incorrect format or type and does it generate an appropriate error message?	☐	☐	☐
100.	Does the error message clarify the type and range of data expected?	☐	☐	☐
101.	Are units for performance data clearly labeled?	☐	☐	☐
102.	Do the labels used in the EFB match the language of other operator documents?	☐	☐	☐
103.	Is all the information necessary for a given task presented together or easily accessible?	☐	☐	☐
104.	Can the crews modify performance calculations easily, especially when making last-minute changes?	☐	☐	☐
105.	Are outdated results of performance calculations deleted when modifications are entered?	☐	☐	☐
106.	Does the display and/or crew training provide information to the crew on the assumptions on which the calculations are based?	☐	☐	☐
107.	Are crews trained to identify and review default values and assumptions about the aircraft status or environmental conditions?	☐	☐	☐
108.	Are the assumptions made about any calculation as clear to pilots as similar information would be on a tabular chart?	☐	☐	☐

Notes: *1. A "NO" response on the checklist must be accompanied by reason or comments.* *2. Precede all comments with the applicable checklist item number.*
Comments:

Name:	LAST NAME, FIRST NAME	**Signature:**	**Date:**	YYYY MM DD

APPENDIX 4 - ELECTRONIC FLIGHT BAG OPERATIONAL EVALUATION

Type of Operation	Name of Operator
☐ Air Operator (Schedule) ☐ Air Operator (Charter) ☐ Helicopter Operations ☐ Other: SPECIFY IF OTHER IS TICKED	NAME OF OPERATOR

Aircraft Type	EFB Manufacturer / Make / Model	Type of Hardware			Type of Software		
Aircraft Type	Manufacturer / Make / Model	☐ Class 1	☐ Class 2	☐ Class 3	☐ Type A	☐ Type B	☐ Type C

GENERAL EFB HARDWARE		YES	NO	N/A
1.	Is there a backup source in the flight deck for EFB information?	☐	☐	☐
2.	Is the EFB display readable under all typical flight-deck lighting conditions?	☐	☐	☐
3.	Does each type of EFB failure have minimum impact to crew tasks and workload?	☐	☐	☐
4.	Is the EFB installation appropriate for use in high workload phases of flight?	☐	☐	☐
5.	Are there appropriate Master Minimum Equipment List (MMEL)/minimum equipment list (MEL) items to handle EFB failures?	☐	☐	☐
6.	Does the EFB mount allow appropriate access to flight controls and displays?	☐	☐	☐
7.	Does the EFB mount allow appropriate access to the emergency egress path?	☐	☐	☐
8.	Are crews able to adjust and lock the EFB for optimal viewing?	☐	☐	☐
9.	Is there appropriate access to all flight controls during both ground and in-flight operations when the EFB is positioned for optimal viewing?	☐	☐	☐
10.	Is there appropriate room to manipulate the EFB controls and to view its display?	☐	☐	☐
11.	Are all routinely used EFB hardware components easy to access?	☐	☐	☐
12.	Are the EFB hardware components usable and suitably durable for the flight deck?	☐	☐	☐

STOWAGE (IF APPLICABLE)		YES	NO	N/A
13.	Is there a stowage area for the EFB?	☐	☐	☐
14.	Is the stowage securing mechanism simple to operate?	☐	☐	☐
15.	Is the stowage securing mechanism unobtrusive when not in use?	☐	☐	☐
16.	Does the stowage system allow appropriate access to flight controls/displays and egress routes?	☐	☐	☐
17.	Is the design of the stowage area acceptable?	☐	☐	☐
18.	Can the EFB be moved easily to and from the stowage area without blocking access to flight displays/controls?	☐	☐	☐
19.	Are the device and/or the stowage area unlikely to be damaged under normal use?	☐	☐	☐

UNSECURED EFB (IF APPLICABLE)		YES	NO	N/A
20.	Is there appropriate access to flight controls/displays when the unsecured EFB is in use?	☐	☐	☐
21.	Is there an acceptable place to put an unsecured EFB when in use?	☐	☐	☐
22.	Is there an acceptable place to put an unsecured EFB when not in use?	☐	☐	☐
23.	Can the kneeboard EFB be positioned so the pilot has full control authority?	☐	☐	☐
24.	Is the kneeboard EFB comfortable for the pilot to wear under normal conditions?	☐	☐	☐

GENERAL USER INTERFACE		YES	NO	N/A
25.	Is the workload using the EFB the same or less than the current process?	☐	☐	☐
26.	Is the workload acceptable when there is an EFB failure?	☐	☐	☐
27.	Are other than critical EFB messages inhibited during high workload phases of flight?	☐	☐	☐

28.	Is the EFB user interface consistent with other flight deck systems?	☐	☐	☐
29.	Does the EFB use terms, icons, colors and symbols consistent with other flight deck systems?	☐	☐	☐

SOFTWARE APPLICATIONS		**YES**	**NO**	**N/A**
30.	Is the workload acceptable when configuring electronic charts while flying a procedure?	☐	☐	☐
31.	Does using the electronic checklist produce the same crew actions the paper equivalent would?	☐	☐	☐

EFB PROCEDURES		**YES**	**NO**	**N/A**
32.	Are there procedures for starting up and shutting down the EFB?	☐	☐	☐
33.	Are there appropriate procedures for all the EFB failure modes?	☐	☐	☐
34.	Are there EFB procedures for when other aircraft system failures could render the EFB unusable?	☐	☐	☐
35.	Are there procedures for using EFB backup information?	☐	☐	☐
36.	Are there procedures to mitigate EFB workload?	☐	☐	☐
37.	Are there procedures for establishing which source of information is primary?	☐	☐	☐
38.	Are there appropriate procedures for using EFB in high workload phases of flight?	☐	☐	☐
39.	Are there procedures specifying what data to use when data is redundant or different from the EFB?	☐	☐	☐
40.	Are there procedures for removal of a kneeboard EFB during emergency landing or egress (If Applicable)?	☐	☐	☑

PROCEDURES FOR KEEPING EFB CONTENT/DATA CURRENT		**YES**	**NO**	**N/A**
41.	Are there procedures to ensure data is accurate and current for each software application?	☐	☐	☐
42.	Are changes to content/data appropriately documented?	☐	☐	☐
43.	Are there procedures to notify crews of EFB updates?	☐	☐	☐
44.	Are there procedures to ensure the correct information is installed when EFBs use information specific to the aircraft type or tail number?	☐	☐	☐
45.	Is there a procedure to avoid corruption/errors during changes to the EFB device?	☐	☐	☐
46.	Is there a procedure to ensure all EFBs have the appropriate content/data installed when there are multiple EFBs on the flight deck?	☐	☐	☐
47.	Is there a procedure to ensure EFB data in use is approved for use in-flight?	☐	☐	☐
48.	Is there a procedure for when the database is not approved for use in-flight?	☐	☐	☐
49.	Is there a procedure to ensure all customized values are cleared from the EFB?	☐	☐	☐

PROCEDURES FOR USER FEEDBACK		**YES**	**NO**	**N/A**
50.	Is there a procedure for EFB users to provide feedback?	☐	☐	☐
51.	Is there a procedure for the operator to monitor feedback, correct EFB deficiencies, and/or notify the EFB manufacturer?	☐	☐	☐
52.	Are there procedures or built-in limits preventing the setting of customized color schemes conflicting with flight deck color conventions?	☐	☐	☐
53.	Is there a policy regarding the use of supplemental audio and/or video in-flight?	☐	☐	☐
54.	Is the EFB audio set to minimize any interference with higher priority communications?	☐	☐	☐

PROCEDURES FOR SPECIFIC APPLICATIONS (IF APPLICABLE)		**YES**	**NO**	**N/A**
55.	Are there specific policy/procedures for using the electronic charts application?	☐	☐	☐
56.	Does the policy specify what other EFB applications can be used while a procedure using the electronic charts is actively being flown?	☐	☐	☐

57.	Are there procedures on how to use the electronic charts when the EFB uses aircraft status data to configure chart elements?	☐	☐	☐
58.	Are there procedures to ensure navigation/approach charts required for the flight are installed and available?	☐	☐	☐
59.	Is there a procedure to identify the controlling copy of Weight and Balance (W&B)?	☐	☐	☐
60.	Is there a procedure to establish responsibility for completion of W&B software applications?	☐	☐	☐
61.	Are there procedures to maintain required W&B records?	☐	☐	☐
62.	Is there a procedure to ensure EFB performance data can be stored outside the EFB?	☐	☐	☐

EFB TRAINING		**YES**	**NO**	**N/A**
63.	Are there appropriate EFB training, checking, and currency requirements?	☐	☐	☐
64.	Does the EFB training program address all EFB intended functions and applications?	☐	☐	☐
65.	Is there training on how to use unique features of the software applications?	☐	☐	☐
66.	Are crews proficient on the EFB at the completion of EFB training?	☐	☐	☐
67.	Is EFB training customized for new users?	☐	☐	☐
68.	Is the manufacturer's EFB documentation sufficient?	☐	☐	☐
69.	Does the EFB training device provide an appropriate degree of fidelity when the actual EFB is not used?	☐	☐	☐
70.	Does the EFB training device simulate the key aspects of the task?	☐	☐	☐
71.	Does the EFB training appropriately address the meaning of icons and symbols?	☐	☐	☐

TRAINING FOR CHARTS (IF APPLICABLE)		**YES**	**NO**	**N/A**
72.	Is training on the use of electronic charts appropriate?	☐	☐	☐
73.	Is there training on unique features of the electronic charts?	☐	☐	☐
74.	Is there training on differences in map scale, orientation, and data quality between the electronic charts and other flight deck displays?	☐	☐	☐
75.	Is there training on the limitations of own aircraft position when it is displayed?	☐	☐	☐
76.	Is there training on policies pertaining to use of the electronic charts?	☐	☐	☐
77.	Can crews use the electronic charts as well as paper charts?	☐	☐	☐
78.	Can crews use the electronic charts to orient themselves and track their progress as they fly required procedures?	☐	☐	☐

TRAINING FOR ELECTRONIC CHECKLIST SYSTEMS (IF APPLICABLE)		**YES**	**NO**	**N/A**
79.	Is there appropriate training on how to use Electronic Checklists?	☐	☐	☐
80.	Is there training on how to use unique features of the Electronic Checklists (e.g., how the EFB indicates a checklist item has been deferred)?	☐	☐	☐
81.	Is there training on which checklists are supported electronically and which are not?	☐	☐	☐
82.	Is there training on the limitations of Electronic Checklist automation when it uses aircraft status data?	☐	☐	☐

TRAINING FOR FLIGHT PERFORMANCE CALCULATIONS (IF APPLICABLE)		**YES**	**NO**	**N/A**
83.	Is there appropriate training on how and when to use the flight performance software application?	☐	☐	☐
84.	Is there training on critical performance calculation assumptions (e.g., runway length, W&B)?	☐	☐	☐
85.	Is there training to review default values for aircraft status and environmental conditions?	☐	☐	☐
86.	Is there training on how to enter information required by the performance software applications?	☐	☐	☐
87.	Is there training on how to interpret and use results of the flight performance calculations?	☐	☐	☐
88.	Is there training on where to obtain values when their normal sources are not available?	☐	☐	☐
89.	Is there training on coordinating the roles of dispatchers and pilot/crewmember?	☐	☐	☐

CREWS PERFORMANCE: PREFLIGHT PLANNING	YES	NO	N/A
Do crews with the EFB perform as well or better than crews with paper documents when:			
90. Calculating aircraft W&B, takeoff, climb, and maneuvering speeds?	☐	☐	☐
91. Crews maintain critical data for immediate reference?	☐	☐	☐
92. There is a runway change and a need to reference deicing fluid requirements or an MEL item?	☐	☐	☐
93. There are time critical adjustments prior to block out/taxi and takeoff?	☐	☐	☐

CREWS PERFORMANCE: TAKEOFF	YES	NO	N/A
Do crews with the EFB perform as well or better than crews with paper documents when:			
94. There is a takeoff on a runway requiring a briefing for a special operator engine-out procedure?	☐	☐	☐
95. There is complex Standard Instrument Departure (SID) with an abnormal or an emergency during the departure climb-out?	☐	☐	☐
96. There is an emergency requiring a return to the departure or alternate departure airport?	☐	☐	☐
97. One EFB fails, requiring one pilot to rely on the EFB of the other pilot immediately after takeoff?	☐	☐	☐

CREWS PERFORMANCE: CRUISE	YES	NO	N/A
Do crews with the EFB perform as well or better than crews with paper documents when:			
98. There is an engine failure/fire with possible condition of destination below weather minimums?	☐	☐	☐
99. There is electrical smoke in the cockpit requiring use of smoke mask/goggles while completing checklists or using EFB for approach briefing?	☐	☐	☐

CREWS PERFORMANCE: DESCENT	YES	NO	N/A
Do crews with the EFB perform as well or better than crews with paper documents when:			
100. There are conditions requiring reference to Surface Movement Guidance and Control System (SMGCS) taxi routing or a complex clearance?	☐	☐	☐
101. Reported runway conditions require reference to operational limitations?	☐	☐	☐

CREWS PERFORMANCE: APPROACH AND LANDING	YES	NO	N/A
Do crews with the EFB perform as well or better than crews with paper documents when:			
102. There is runway change or the need to re-compute landing weight and V speeds during approach?	☐	☐	☐
103. There are poor weather conditions or airports with complex taxi routes?	☐	☐	☐
104. There is a request for a specific taxiway turn during rollout after landing?	☐	☐	☐

CREWS PERFORMANCE: DESTINATION GROUND OPERATIONS	YES	NO	N/A
Do crews with the EFB perform as well or better than crews with paper documents when:			
105. There is an EFB partial failure or erroneous output requiring maintenance discrepancy to be entered?	☐	☐	☐

Notes: *1. A "NO" response on the checklist must be accompanied by reason or comments.*
2. Precede all comments with the applicable checklist item number.

Comments:

Name: LAST NAME, FIRST NAME **Signature:** **Date:** YYYY MM DD

APPENDIX 5 – SAMPLE OPERATIONS SPECIFICATION DURING EVALUATION PERIOD

A061. Use of Electronic Flight Bag TTCAR No. 2:76A

a. Authority. ABC Airlines is authorized to conduct operations using an Electronic Flight Bag (EFB) in accordance with the limitations and provisions of this operations specification.

b. Class 1 Devices. ABC Airlines is authorized to use Class 1 EFB devices with the associated Type B software as listed in Table 1.

c. Training Program. ABC's approved training program must include appropriate flight crew training on the use of any EFB listed in Table 1.

d. Database Management. ABC Airlines must specify in its manual the procedures for updating and maintaining any databases necessary to perform the intended functions of the EFB.

e. Functionality. ABC Airlines is responsible to ensure that the EFB and associated software will provide the necessary data, information, functionality, and solutions to perform the intended flight functions and, if not, provide substitute information in non-electronic form.

TABLE 1

Aircraft Type Make /Model /Series	Hardware Make / Model	EFB Software Source / Type / Version	Restrictions And Limitations
Sikorsky 76D	MS Surface Studio 2 MS Surface Pro 4	• Sikorsky iFly V3.3 • vmware Airwatch V4.2	• Temporary Authorization to conduct 6-month operational validation testing. • All paper manuals/charts must be on board during the 6-month evaluation period. • During the 6-month evaluation, data collection and reliability reports submissions to the Authority will be required on a monthly basis.

APPENDIX 6 – SAMPLE OPERATIONS SPECIFICATION

A061. Use of Electronic Flight Bag TTCAR No. 2:76A

a. Authority. ABC Airlines is authorized to conduct operations using an Electronic Flight Bag (EFB) in accordance with the limitations and provisions of this operations specification.

b. Class 2 Devices. ABC Airlines is authorized to use Class 2 EFB devices with the associated Type B software as listed in Table 1.

c. Training Program. ABC's approved training program must include appropriate flight crew training on the use of any EFB listed in Table 1.

d. Database Management. ABC Airlines must specify in its manual the procedures for updating and maintaining any databases necessary to perform the intended functions of the EFB.

e. Functionality. ABC Airlines is responsible to ensure that the EFB and associated software will provide the necessary data, information, functionality, and solutions to perform the intended flight functions and, if not, provide substitute information in non-electronic form.

TABLE 1

Aircraft Type Make /Model /Series	Hardware Make / Model	EFB Software Source / Type / Version	Restrictions And Limitations
Boeing 767-300	Apple iPad Air 2 Apple iPad Pro 10.1	• Jepessen Flite Deck Pro V2.2 • ForeFlight Performance V1.2	No Restrictions