U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

NOTICE
N 8200.98

Effective Date:
10/13/06
Cancellation Date:
10/13/07

SUBJ: ELECTRONIC FLIGHT BAG JOB AID

1. PURPOSE. This notice provides guidance for all Flight Standards District Offices (FSDO), including principal inspectors (PI) that oversee and authorize operators to use electronic flight bag (EFB) computing devices for operational flights, in accordance with Title 14 Code of Federal Regulations parts 91, 121, 125, 129, and 135.

2. DISTRIBUTION. We will distribute this notice to the division level in the Flight Standards Service in Washington headquarters, including the Regulatory Standards Division at the Mike Monroney Aeronautical Center; to the branch level in the regional Flight Standards divisions; and to all Flight Standards District Offices. Inspectors can access this notice through the Flight Standards Information Management System (FSIMS) at http://fsims.avr.faa.gov. Operators may find this information on the Federal Aviation Administration's (FAA) Web site at: http://www.faa.gov/library/manuals/examiners_inspectors/8000/.

3. BACKGROUND. EFBs are electronic display systems intended primarily for cockpit, flight deck, or cabin use.

a. EFB Functionality. EFB devices can display a variety of aviation data or perform basic calculations (e.g., performance data, fuel calculations, etc.). In the past, flightcrews performed some of these functions using paper references or data provided to the flightcrew by an airline's "flight dispatch" function.

(1) The scope of the EFB system functionality may also include various other hosted databases and applications.

(2) Physical EFB displays may use various technologies, formats, and forms of communication. We sometimes refer to these devices as "auxiliary performance computers" (APC) or "laptop auxiliary performance computers" (LAPCs).

(3) EFBs appear to have value in a number of areas, including as a document browser, for electronic charting, as an electronic logbook, as a display of general operations manuals and minimum equipment lists, for making performance calculations, for video surveillance, and for calculating weight and balance.

b. EFB Job Aid. This notice clarifies policy regarding the approval process for operational use of EFBs.

(1) We have tested the EFB Operations Job Aid (attached to this notice) in the field. We have determined it is the best resource for field inspectors when considering an application for the installation or use of an EFB.

(2) The attached job aid describes, in detail, the evaluation and approval process Flight Standards inspectors must use during the course of evaluating applications for installation and use of EFBs.

4. ACTION.

a. FSDOs and PIs.

(1) Review the attached job aid and adhere to the prescribed evaluation process as closely as possible to ensure you process applications in a standardized manner and with the requisite depth and detail.

(2) When an operator requests information regarding the application, evaluation, or approval process required by the FAA for EFBs, refer them to the electronic version of the notice and its attachment located at http://www.faa.gov/library/manuals/examiners_inspectors/8000/.

b. Aircraft Evaluation Group (AEG). AEGs must evaluate EFB "type B" software applications. This evaluation will document EFB "non-interference compliance" in accordance with the guidance in the current version of Advisory Circular 91.21-1, Use of Portable Electronic Devices Aboard Aircraft.

> **NOTE: The Aircraft Certification Service (AIR) must provide design approval for "class 3" mounting of EFB hardware on an aircraft. "Type C" EFBs, which are "built –in" an aircraft, also require design approval from AIR.**

5. TRACKING. Use the Program Tracking and Reporting System codes contained in the attached EFB job aid to document EFB actions for each air carrier affected.

6. DISPOSITION. We will permanently incorporate the information in this notice in FSIMS before this notice expires. Questions concerning this notice should be directed to the Flight Technology Requirements Branch, AFS-430, at (202) 385-4612.

/s/ Carol Giles for
James J. Ballough
Director, Flight Standards Service

Attachment

Job Aid

Electronic Flight Bag (EFB)
Operational Evaluation and Approval

Version 2.0

September 2006

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Preface

This document was produced by the Federal Aviation Administration (FAA) Aircraft Certification Service and Flight Standards Service with special assistance from the Research and Innovative Technology Administration Volpe National Transportation Systems Center (Volpe Center, Cambridge, MA).

Portions of this report were prepared by the Human Factors Division of the Office of Aviation Programs at the Volpe Center. The Volpe Center was funded by the FAA Human Factors Research and Engineering Division (AJP-61) in support of Aircraft Certification and Flight Standards. Dr. Tom McCloy served as the FAA program manager for the Volpe Center support.

Feedback on this document should be sent to the Federal Aviation Administration to Peter Skaves (AIR-130) (peter.skaves@faa.gov) or Rich Adams (AFS-430) (rich.adams@faa.gov).

Executive Summary

This Job Aid provides clarification and further elaboration of the material in Advisory Circular (AC) 120-76A *"Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices"* for Federal Aviation Administration (FAA) Flight Standards field inspectors who provide the operational approvals of these devices. The scope of the Job Aid is limited to that covered in the AC. This Job Aid should be used in combination with AC 120-76A.

Specifically, this Job Aid provides guidance information in two primary areas:

(1) FAA internal processes to be used by the Aircraft Evaluation Group (AEG) and Flight Standards District Office (FSDO) for evaluations and operational approvals, and

(2) the design and technical criteria for the approval of EFB systems (e.g., human/machine interface).

The primary intended audience for this material is the FAA inspector. However, the materials may also be useful to EFB manufacturers and operators.

This document is written from an internal Flight Standards perspective. Its appendices help the reader to (a) understand the answers to frequently asked questions about AC 120-76A and the EFB approval process, and (b) determine how to classify an EFB system, create an application for approval, and conduct a variety of EFB human factors assessments.

Use of this Job Aid is at the discretion of the FAA inspector. The inspector can choose to use all or part of this during an EFB operational approval. In addition, the inspector may customize use of this material for the specific situation.

1. PURPOSE. This document outlines the operational approval process for Class 1, 2 and 3 EFBs by Principal Inspectors (PIs) in a Flight Standards District Office (FSDO) and serves to facilitate the interaction of the PI with the Aircraft Evaluation Group (AEG) when applicable. It is intended to provide additional clarification to supplement the recommendations and processes outlined in the Federal Aviation Administration (FAA) Advisory Circular (AC) 120-76A, titled Certification, Airworthiness, and Operational Approval of Electronic Flight Bags. The FAA approval team (the assigned PI, AEG and Aircraft Certification Office (ACO), when applicable) may use this document in combination with AC 120-76A to conduct EFB evaluations. This Job Aid is not meant to replace AC 120-76A.

Use of this Job Aid is at the discretion of the FAA inspector. The inspector can choose to use all or part of this during an EFB operational approval. In addition, the inspector may customize use of this material for the specific situation.

This document has nine appendices, listed below. The appendices are provided as guides and job aids to assist inspectors in the FSDOs and AEG offices in performing their respective tasks and integrating FSDO, AEG and ACO activities. An explanation of frequently used acronyms is provided in Paragraph 14. Manufacturers and operators may find the attached job aids useful during the design, development, and preparation for FSDO/PI operational approval and for AEG human/machine interface evaluations.

Appendix 1. EFB Operational Approval Process
Appendix 2. Flow Chart for Determining Hardware Class
Appendix 3. Flow Chart for Determining Software Application Type
Appendix 4. Information for an Application and Sample Requests
Appendix 5. EFB Line-Operations Evaluation Job Aid
Appendix 6. Guide for Developing Simulator and Validation Flight Scenarios
Appendix 7. Operational Evaluation Questions
Appendix 8. AC 120-76A Frequently Asked Questions (FAQs)
Appendix 9. EFB User-Interface Assessment Tool

2. DISTRIBUTION. This document has been distributed in Washington headquarters to the Office of Aviation Safety (AVS-1) and to the branch level in the Aircraft Certification (AIR) and Flight Standards Service (AFS); to branch level in the regional Flight Standards divisions; section level in all Aircraft Certification Directorates, all Aircraft Certification Offices (ACOs), all Flight Standards Certificate Management Offices (CMOs), all Flight Standards District Offices (FSDOs), and all Aircraft Evaluation Group (AEG) field offices.

3. BACKGROUND. Advisory Circular (AC) 120-76A was published on March 17, 2003. Since the date of publication, the aviation community has gained experience using AC 120-76A and has raised a number of questions regarding the document's content and applications. An EFB approval process that includes the CMO/FSDO, AEG and, as required, an ACO, is outlined in AC 120-76A. The further clarification and job aids of this document are provided to assist field personnel in the evaluation and operational approval process. Appendix 1 provides a guide for understanding the recommendation of AC 120-76A regarding use of the FAA five-phase approval process. Appendices 2 and 3 provide flow charts to determine EFB hardware class and software types, respectively, using the definitions in AC 120-76A. Appendix 8 contains answers to frequently asked questions about AC 120-76A. This document is intended for use in conjunction with the recommendations and provisions of FAA AC 120-76A.

4. SCOPE. AC 120-76A and the guidelines of this document form the basis for the operational approval process by Flight Standards field personnel. Both the AC and this document may prove useful to operators in the evaluation and operational approval of their EFB system when transitioning from paper chart products, company manuals, etc. to an electronic format. It is expected that the combination of this information with other material contained in current Communication, Navigation, and Surveillance (CNS) ACs or other FAA-approved guidance material will form the basis for the approval and the applicable certification process. It is not intended to supersede existing AIR certification policies or guidance material relative to EFB certification approvals.

5. APPROVAL. The EFB should be evaluated in terms of providing an equivalent or better level of safety than the non-electronic system required by 14 CFR that the EFB is being used to replace. For operators with approved programs (i.e. Part 91K, 135, 121, etc.), this process includes FAA approval of applicable operating procedures, pertinent training modules, checklists, operations manuals, training manuals, maintenance programs, MELs, etc.

a. Air Carrier/Commercial Operator Approval. Operators should submit an application for the applicable operations specifications (OpSpecs) or management specifications (MSpec for 91K) to their CMO/FSDO in a manner consistent with AC 120-76A and this document. See Appendix 4 for a list of information for an application and two sample application letters. For EFB applications requiring AEG review, specific information provided in this document is intended to facilitate the approval process.

b. General Aviation Approval. AC 120-76A applies to operators of large and turbine-powered multi-engine aircraft (other than Part 91K, as explained above) operating under part 91, subpart F, where the operating regulations require specific functionality and/or equipage. Other Part 91 operations do not require any specific authorization for EFB operations provided the EFB does not replace any system or equipment required by the Federal Aviation Regulations. This document and its appendices may provide best practices for any Part 91 operator desiring to implement electronic flight bag technology. Approval of an EFB to replace any required functionality and/or equipage may take the form of a certification approval or AEG specified requirements through an FSB report. Part 91 operator applications to a FSDO will be coordinated with the appropriate AEG and/or ACO.

c. Approval Process. For all operators holding OpSpecs or MSpecs, provisions of FAA AC 120-76A and this document apply. The standard OpSpecs or Mspecs will be used by the PI for operational authorization. The five-step process described in Appendix 1 is normally accomplished sequentially. Each step is dependent on FAA and applicant coordination.

6. PROGRAM TRACKING AND REPORTING SUBSYSTEM (PTRS) INPUT. Aviation Safety Inspectors (ASIs) must make appropriate PTRS entries for each of their operators to record the actions directed by this document as outlined in HBAT 00-13A, “Program Tracking and Reporting Subsystem (PTRS) Documentation of Action Required by Flight Standards Bulletins.” (ASIs) should use the comments section to record comments of interaction with the operators.

7. OPERATIONS SPECIFICATIONS. For part 121, 125, and 135 certificate holders, final authorization takes the form of OpSpec A025 approval. FAA Order 8400.10, Volume 3, Chapter 1, Section 3, Part A, Operations Specifications (121/135), and FAA Order 8700.1, Operations Inspector’s Handbook, Volume 2, Chapters 73 and 76, contain general policy guidance and requirements for issuing or amending OpSpecs paragraphs for Part 125 operators proposing to install and conduct operations using EFB systems and associated displays. Part 91K operators will be issued MSpec M025.

8. DOCUMENTATION FOR PART 91 OPERATORS. Part 91 operators not holding MSpecs will be provided specific airworthiness documentation as necessary (e.g., Supplemental Type Certificate, Aircraft Flight Manual Supplement (AFMS), etc.).

9. EFB CLASS AND SOFTWARE TYPES. AC 120-76A provides detailed information and definitions for the various classes of EFBs and types of software. In addition to the applications listed in Appendices A and B of the Advisory Circular, the AEG assigned to the aircraft will have a record of Flight Standardization Board (FSB) Reports on file that contain hardware and software applications/functions that have been evaluated and the level of approval granted in those evaluations. Operations Safety System (OPSS) web site (http://www.opspecs.com) contains a link to the FSB reports. (Note: Microsoft® Internet Explorer is needed to view this website properly.) PIs and operators should pay particular attention to the defining requirements for hardware classification and software types contained in AC 120-76A. Provision for additional software functionality is provided through an applicant contacting either the appropriate Aircraft Evaluation Group (AEG) or Aircraft Certification Office (ACO).

10. SPECIFIC AREAS REQUIRING EVALUATION. The guidance is presented in terms of the EFB system functions and characteristics to be considered and the operational tasks to be evaluated. The evaluation of an operational task involves consideration of the operator's knowledge, skills, abilities, and other qualifications in at least the areas indicated below and further described in AC 120-76A. The FAA evaluation team must examine the EFB and hosted data as it relates to the operator's policies, training and integration into their system. Appendix 1, EFB Operational Approval Process, contains a list of probable documents and required items to review for adequacy and accuracy when an operator's system is transitioned to electronic form. The primary operational evaluation for incorporating EFBs should document that the operator has considered all applicable aspects of incorporating an EFB into cockpit or cabin operations regarding the following areas.

a. Risk Mitigation for EFB Systems. In preparation for transition to a paperless cockpit, the operator must establish a reliable backup means of providing the information required by the regulations to the flightcrew. During this period, an EFB system must demonstrate that it is as available and reliable as the current paper information system. If an operator wants to transition to a paperless cockpit, an acceptable process should be developed with the operator's PI following the recommended risk mitigation practices in AC 120-76A. During the 6-month evaluation period, it is only intended that back-up paper products be available to the crew, not necessarily displayed in the cockpit.

NOTE*:* When complete removal of the paper-based information associated with a particular EFB application is proposed, the operator must obtain PI approval for Type A, or a final FSB evaluation report for Type B, and OpSpec or MSpec A025. These requirements also apply to an operator who intends to begin operation of any aircraft type without paper-based information.

b. System Design Considerations. The design of Class 2 and 3 EFBs are subject to AEG and AIR evaluation. Depending upon the intended functionality and method of installation or mounting, there will be one or more associated approvals or acceptances. Class 1 EFBs are normally only subject to a PI operational evaluation and approval. The installation or mounting of a device in the cockpit requires an appropriate airworthiness approval (i.e., original or follow-on STC, etc.). The FSDO or a PI is not expected to perform design evaluations for Class 1 systems, but only to ensure the adequacy of its operational use. The PI should check the OPSS web site for an FSB report for a Class 1 EFB, as one may exist depending upon prior utilization and software installed. The footnotes in Appendix 2 clarify the interaction of the PI, AEG, and AIR relative to acceptance procedures for all hardware

classes of EFB. At a minimum, the PI, with assistance from the AEG as appropriate, must ensure that the following areas explained in detail in AC 120-76A have been adequately addressed prior to operational approval:

- Use of Aircraft Electrical Power Sources.
- Electrical Backup Power Source.
- Environmental Hazards Identification and Qualification Testing.
- Rapid Depressurization Testing (if available to support operator's risk mitigation).
- EFB Mounting Devices.
- Stowage Area for EFB Systems.
- EFB System Data Connectivity with Other Aircraft Systems.
- Integrity Considerations.

c. Functional Areas Requiring Evaluation. The applicable FSB report, Aircraft Flight Manual Supplement, STC, etc. provide PIs and operators the guidance and requirements for addressing the major safety concerns associated with installation and operation of an EFB with specified software and functionality. The FSB process cannot take into account all aspects of follow-on installations, conflict with added software, and ultimately the interface relative to each individual operator's methods and procedures.

11. HUMAN/MACHINE INTERFACE CONSIDERATIONS FOR PORTABLE AND INSTALLED CLASSES 1, 2 AND 3 EFB SYSTEMS. The human/machine interface characteristics of the EFB system shall be evaluated as per the recommendations of AC 120-76A prior to operational use. Special attention should be paid to new or unique features that may affect pilot performance. Class 3 EFB equipment evaluations are generally not the direct responsibility of a principal inspector (i.e. POI or PAI), but are performed by Aircraft Certification (AIR) and the Aircraft Evaluation Group (AEG) assigned to the aircraft. Similarly, Class 2 EFB systems including Type B and C software will require the involvement of an AEG and potentially AIR where data connectivity and other critical interactive functions are involved.

The AEG's Flight Standardization Board (FSB) report must be utilized by the operator and PI before proceeding with an in-flight operational evaluation although certain exceptions may exist for AEG data collection. An operator presenting a Class 1, 2, or 3 EFB approved for another operator, or in another aircraft belonging to the operator, must always demonstrate that the operator's procedures, training, system security, etc. are adequate for the intended operation in that aircraft type and considering variations in aircraft software and systems within type.

For a new Class 1 EFB presented to the FAA, it is possible that no human/machine interface evaluation was conducted by AEG and therefore the PI must ensure the adequacy of that system for operational use for that operator. Where intended use is for non-critical phases of flight, or on the ground only, a less intensive validation is possible.

Four appendices are provided to assist with evaluation of the procedures and human/machine interface aspects of EFBs. Appendix 5, the Line Operations Evaluation Job Aid, is intended for use during observation flights. An evaluator can use this brief tool during or after a flight to record notes about the use of the EFB. The operator could also use a tailored version of the Line Operations Evaluation Job Aid during the operational evaluation period to gather data for a final report. Appendix 6, Guide for Developing Simulator and Validation Flight Scenarios, can be used to develop scenarios for simulated or actual validation flight evaluations. AC 120-76A, paragraph 12 (j), provides background on recommended simulator and flight evaluation

requirements. Appendix 7, Operational Evaluation Questions, provides a list of questions to ensure that the human/machine interface aspects are adequately addressed. Appendix 9, EFB User-Interface Assessment Tool, provides a list of topics that can be used at any time to identify issues with the way that the user and system work together. Use of these aids by the operator may assist expedient FAA operational evaluation.

For electronic display of approach, departure and navigation charts, the appropriate AEG may provide essential assistance to the PI. Refer to AC 120-76A page 12, paragraph 5, a and b, for AEG involvement and the applicable FSB report content. Job aids in Appendices 5, 6, and 7 are provided to assist PIs, AEGs and operators during the preparation of the operator's system for transition to an electronic based system and to provide a recommended assessment of their procedures and the human/machine interface. The level of safety for alternative navigation chart presentations always must be at least the equivalent to that provided by the traditional paper charts.

a. Human Factors Operational Evaluation. The introduction of a new EFB device and/or software requires that the operator and the FAA assure that the proposed change(s) are safe and compatible with the operator's existing procedures and concepts prior to adoption into service. Appendix 7 provides an aid for applicants as well as PIs and the AEG in this evaluation process. For the PI, the operational evaluation questions in Appendix 7 provide a guide as to what he/she may expect to evaluate for a Class 1 EFB with Type A software installed. Normally AEG involvement is required for the acceptance of Type B software (and some Type A), even when installed on Class 1 hardware.

b. EFB System Design and Usability. AC 120-76A provides detailed guidance in each of the following areas related to design characteristics and usability. The EFB user-interface assessment tool in Appendix 9 can also help in evaluating EFB system design and usability. Regardless of the Class of EFB, each of these areas must be addressed, where applicable, and be found acceptable by the FAA approval team relative to the operation intended.

- Human/Machine Interface
- Design of Mounting Device
- Placement of Mounting Device

NOTE: The approval of all mounting devices will be conducted through the appropriate AEG office or AIR as applicable.

- Legibility of Text
- Approach/Departure and Navigation Chart Display

NOTE: Charts displayed on an EFB used during critical phase of flight require an evaluation and approval by the AEG through the FSB process for functionality and human factors.

- Responsiveness of Application
- Off-Screen Text and Content
- Active Regions
- Managing Multiple Open Applications and Documents.
- Input Devices

c. Flightcrew Workload. For the initial operational evaluation of a new EFB, or for the addition of a previously accepted/approved Class 2 EFB in a different type aircraft, the PI will coordinate with the appropriate AEG to determine the method of evaluating flightcrew workload.

NOTE: If the EFB is intended for use during critical phases of flight, such as during takeoff and landing or during abnormal and emergency operations, its use must be evaluated by the AEG during simulated or actual aircraft operations under those intended conditions.

d. Messages and the Use of Colors. AC 120-76A provides recommended aspects to consider. Color recommendations are also contained in Appendix 7, Operational Evaluation Questions.

e. Error and Failure Modes. Error and failure mode requirements are normally established during the FSB process. PIs should review this information for any items applicable for the training program.

f. Procedures. Appendices 1, 5, 6, and 7 are intended to aid the team in determining that the procedural considerations identified in the AC and other industry best practices are evaluated and determined to be adequate.

12. Standards for Application, Evaluation and Approval Process. The general standards in items 1 through 5 below and AC 120-76A apply to all operators subject to an operational evaluation and approval. Some of the elements in item (6) below may be referenced in an FSB report or incorporated in an AFM supplement or other airworthiness document. While Part 91F operators are not required to have an approved training program, during review of the intended EFB use, the operator should be encouraged to adopt applicable policy, procedures and training recommendations especially where procedures or training recommendations are part of an FSB report or manufacturer's recommendation.

The following steps (in chronological order) are required:

(1) Make application in a form and manner acceptable to the FAA.

(2) Demonstrate a process of ensuring initial and continuing reliability for each specific unit.

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

(4) Demonstrate that the units can be properly stored or mounted in the aircraft.

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

(6) Develop a policy and procedures manual that may include, but is not limited to, the following:

- For single-pilot and multi-pilot crew 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 what alternate means to use to obtain 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, or test results, etc.)
- A list of the data loaded and maintained in each unit
- Instructions for Continued Airworthiness (ICAWs) in accordance with the manufacturer's recommendations (also include these instructions in the inspection/maintenance program)

(7) Final approval for use of electronic documents, in lieu of required paper documents, requires:

- Risk mitigation report submitted to PI/AEG
- Reliable EFB system information available for each flight crewmember
- A final FSB evaluation report, and
- Operators must be granted final authorization via issuance of OpSpec A025 or MSpec M025 as applicable. The specification paragraph must reference the company documents, records, or manuals presented with the operator's application.

(8) The operational evaluation may be accomplished by reviewing submissions from the operator, discussing the submissions with the applicant, and/or simulator or flight evaluations as deemed necessary by the FAA approval team. The attached job aids and process guides are to assist both the FAA team and the operator to ensure that the highest standard of safety is achieved in transitioning this technology into flight operations.

NOTE: Simulator and Flight Evaluations. Simulator and/or in-flight validation tests may be needed to fully determine the suitability of an EFB (see AC 120-76A Paragraph 12 (j), pp. 21-22).

a. Simulator Evaluations. Simulators and other approved training devices (such as procedures trainers) may be used by an operator as a tool to evaluate the overall quality of the training given and/or EFB system performance before gaining operational approval. The level of simulation fidelity required depends upon the type of use/credit being sought. Guides to the EFB characteristics and flight deck integration issues that are suggested for simulator evaluation are included in Appendices 4 and 5.

b. Flight Test. The actual requirement for a flight test needs to be evaluated for each request. The PI/AEG would determine if such a demonstration may be accomplished using an approved training device or if an actual flight evaluation is required. For example, first-time model installations and first-time hosted applications will generally require a flight test. Follow-on EFB systems that introduce changes in the EFB system, including software upgrades, may require flight testing if they cannot be adequately evaluated on the ground or in simulations.

13. INQUIRIES. AFS-400, Flight Technology and Procedures Division drafted this document. Special assistance was provided by the Research and Innovative Technology Administration (RITA) Volpe National Transportation Systems Center.

> **NOTE: Inquiries regarding this document should be directed to Rich Adams in the Flight Technologies and Procedures Division (AFS-400) (rich.adams@faa.gov).**

14. LIST OF ACRONYMS. The following is a list of acronyms used throughout this document. Readers can refer to the following alphabetical listing when using this document.

AAC	Aircraft Administrative Communications
AC	Advisory Circular
ACO	Aircraft Certification Office
AEG	Aircraft Evaluation Group
AFM	Aircraft Flight Manual
AFS	Flight Standards Service
AIR	Aircraft Certification
ASI	Aviation Safety Inspector
CMO	Flight Standards Certificate Management Office
CNS	Communication, Navigation, and Surveillance
COTS	Commercial Off-The-Shelf
DP	Departure Procedure
ECL	Electronic Checklist Systems
EFB	Electronic Flight Bag
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FCOM	Flight Crew Operating Manual
FSB	Flight Standardization Board
FSDO	Flight Standards District Office
ICAW	Instructions for Continued Airworthiness
Mspec	Management Specifications
OpSpecs	Operations Specifications
OPSS	Operations Safety System
PAI	Principal Avionics Inspector
PDF	Adobe® Portable Document Format
PEDs	Portable Electronic Devices
PFDs	Primary Flight Displays
PIs	Principal Inspectors
POI	Principal Operations Inspector
PTRS	Program Tracking And Reporting Subsystem
RITA	Research and Innovative Technology Administration

SID	Standard Instrument Departure
SMGCS	Surface Movement Guidance and Control System
SOP	Standard operating procedures
STC	Supplemental Type Certificate
TSOA	Technical Standard Order Authorization

APPENDIX 1

EFB Operational Approval Process

AC 120-76A recommends that the operator and the FAA utilize the established "Five Phase Process" of Order 8400.10. The purpose of this appendix is to outline the typical documents and procedures required from an applicant for a PI to approve the use of an EFB. It is also intended to clarify responsibilities for AEG support. Where an applicant deviates from this guide, Principal Inspectors (PIs) may require documents that establish equivalent procedures or information. It is expected that due to the wide range of capability of EFBs as well as the desired use by each operator, this approval process will vary significantly.

The five-phase process and a detailed list of document compliance items for operators are contained in FAA Order 8400.10 Air Transportation Operation's Inspector's handbook, Volume 3, Chapter 9, Proving and Validation Tests. The following considerations may be unique to an EFB approval process.

Phase One: FAA Notification—The applicant should provide a letter to the PI indicating the desire to approve and implement an EFB on its aircraft. (See Appendix 4 for examples.) Further the operator should schedule and meet with the PI to gain a clear understanding of what reports and documentation needs to be submitted.

Phase Two: Operator Plan Submittal—FAA coordination for AEG and/or AIR support is essential in this phase. An operator's plan would address at least the following eight items:

1. Aircraft certification documentation (i.e., supplemental type certificate).
2. Flight Standards Aircraft Evaluation Group (AEG) **—**FSB report(s), as applicable.
3. AFM supplement/company flight manual/flight manual bulletin.
    a. System Limitations
    b. Abnormal procedures (e.g., outline crew duties in the event of partial or total EFB failure, if more than one EFB is installed, procedures should include failure of one or all EFBs, etc.).
    c. Normal procedures including preflight and post flight checklists.
    d. Operating philosophy and procedures.
    e. Hardware and Software system descriptions.
4. The training program, amended for the user's operation considering the experience level of the crews that will use the system.
5. Minimum Equipment List (FAA coordination for Master MEL if required)
6. General maintenance manual adjustments should:
    a. Document that reasonable security procedures are in place.
    b. Document the procedures used to update the EFB hardware.
    c. Document the procedures used to revise a current application or add another application on the EFB.

d. Verify that the hardware meets the minimum requirements of all the software applications installed on the EFB.

e. Document the procedures used to revise data on the EFB.

7. Maintenance manual documents to include aircraft maintenance manual, illustrated parts catalogue, etc.

8. During the transition period to a paperless cockpit, the operator should provide an acceptable means of risk mitigation (see AC 120-76A, paragraph 9). At the end of the six-month evaluation period the operator should plan for a post-operational evaluation report. Note that the risk assessment may be included with the initial project approval if analysis is done prior to implementation. The report should include an analysis of the training program, procedures and impact on crew performance. These requirements also apply to an operator who intends to begin operation of any aircraft type without paper-based information.

Phase Three: FAA Review and Plan approval—The FAA's completion of its review and analysis in this phase allows the operator to move forward into the operational test (e.g. "six-month evaluation") period. An operator may determine that more or less time is desirable to gather data and meet their objectives. Reduction in the six-month period may be granted by AFS-200.

In some cases an operator may desire to run a limited line test with controlled crew and aircraft participation to validate equipment selection or operational concepts. This may also be done in a certified aircraft simulator. The basic requirements for risk mitigation, initial training and approved procedures always apply and should be closely coordinated with the FAA. The operator implements their plan as approved when the PI grants authority for the 6-month operational evaluation in OpSpec/MSpec A025. The operator may begin installation of the EFB after agreement with the PIs. For first-time installations that may not have a final FSB report until the end of the 6-month operational evaluation, coordination with the AEG is required.

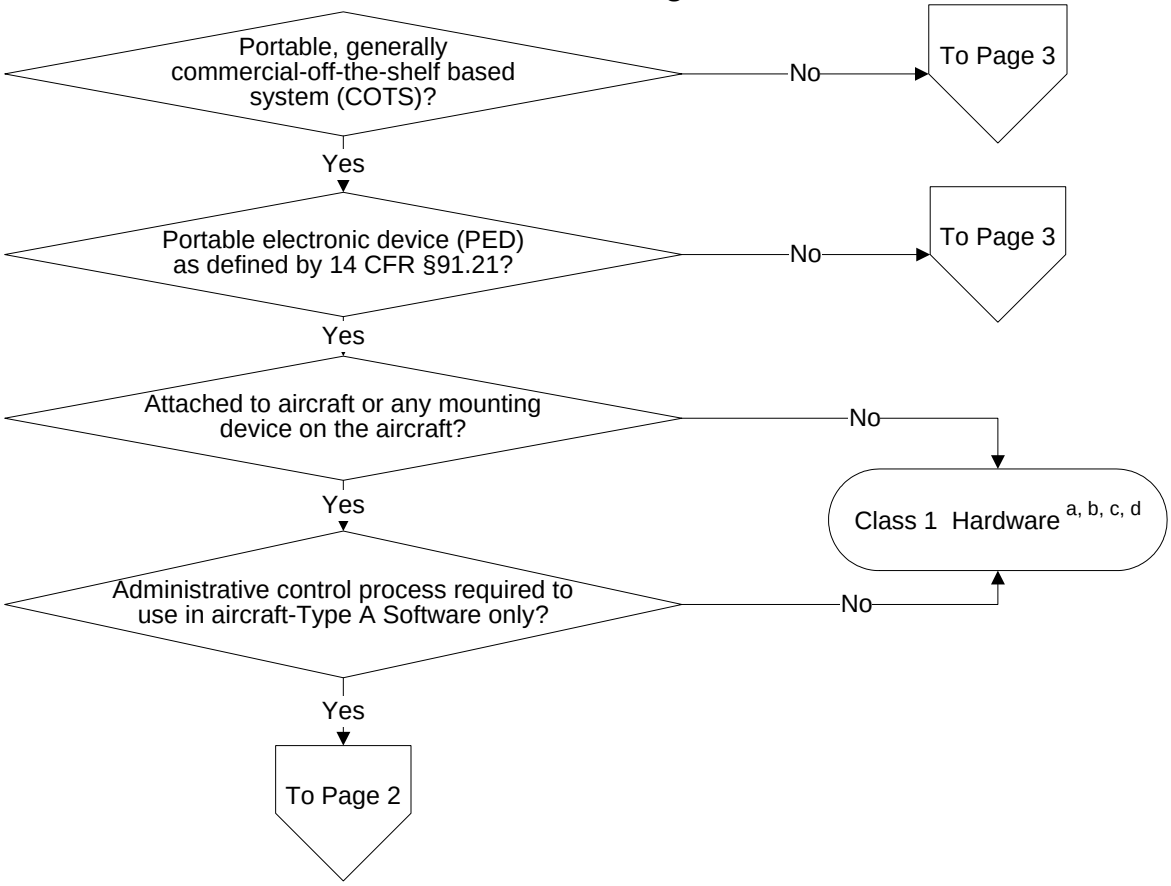
Phase Four: Plan Implementation—This starts the six (6) month implementation phase. In this phase the operator conducts data collection used to complete the final report(s). The company should provide guidance to its personnel regarding evaluation criteria. Job Aids in Appendix 5 and 6 provide suggested topics and questions. The operator may adjust these to suit the complexity of the operation and could provide a numeric or other rating system to better quantify crewmember feedback.

Phase Five: Final FAA Approval—The final approval for successful completion is the issuance of operations specifications for air carriers or management specifications for fractional ownership operations.

NOTE: Part 91F operators may have requirements specified by an aircraft certification TC/STC and/or in an FSB report. At the moment, the only documentation for Part 91F operators would be evidence of compliance with the requirements associated with TC/STC and/or FSB Report(s).

APPENDIX 2

Flow Chart for Determining Hardware Class

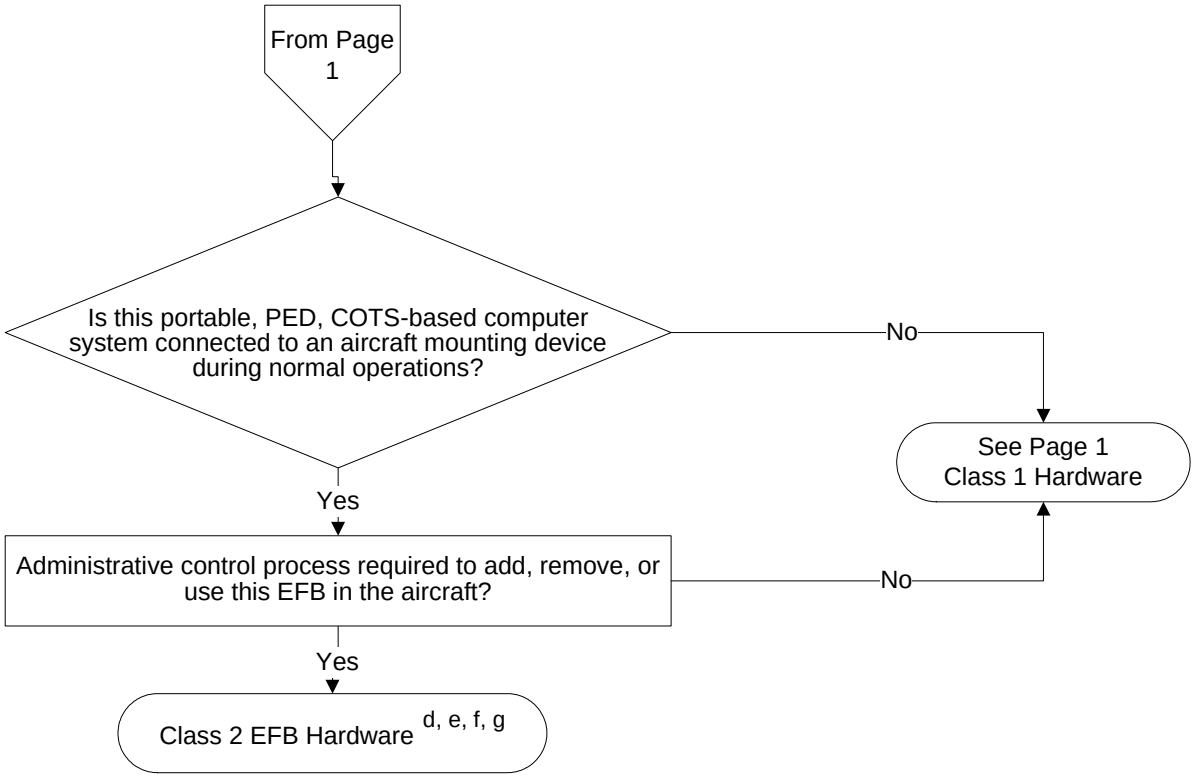


[a] Class 1 EFB Hardware may be used on ground and in flight; may connect to ship's power via certified power source, and recharge batteries onboard aircraft. Requires a quick-disconnect from power and/or data sources for egress. Can only have read-only connectivity to other aircraft systems and receive/transmit connectivity for aircraft administrative communications (AAC).

[b] Aircraft Certification (AIR) & Aircraft Evaluation Group (AEG) Involvement: None, provided no mounting device on aircraft and no connection to aircraft power (unless previously certified); and no data connectivity to any other aircraft system.

[c] Operator Requirements: (1) Develops programs for usage; (2) Demonstrates non-interference compliance per current AC 91.21-1, "Use of Portable Electronic Devices Aboard Aircraft"; and (3) Demonstrates proper stowage or mounting for takeoff and landing.

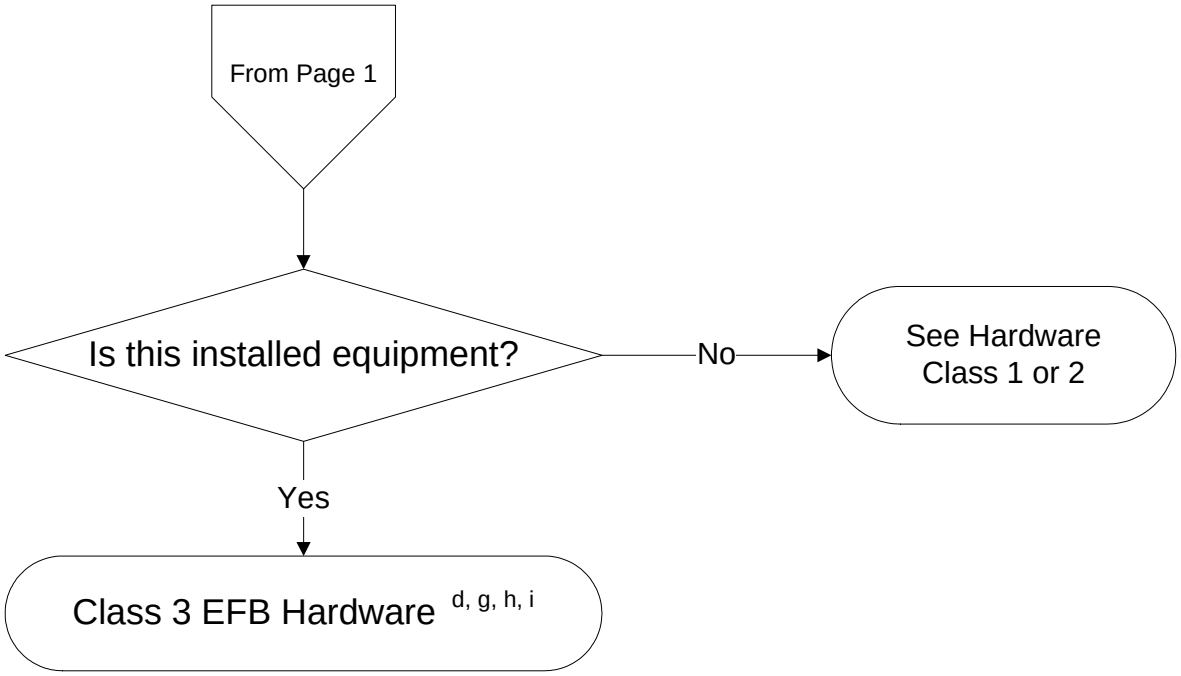
[d] Principal Inspector (PI) Involvement: Verifies that (1) Hardware criteria & operator requirements are met; (2) Data update procedures are in place and followed; (3) For Class 1 and 2 hardware, the power source is certified and data is read-only from other aircraft systems if the EFB is connected to aircraft power source or other aircraft systems; (4) Receive/transmit data connectivity only for AAC; (5) For Class 1 and 2 the Quick disconnect from power and data sources allows egress; (6) Applicable Job Aids, including human factors evaluation, are completed; (7) Training, Checking, and Currency Programs are approved; and (8) Mspec or OpSpec (A025) is issued upon completion of approval process.



[e] Class 2 EFB Hardware:
(1) Mounting devices, power, and data connectivity installed by supplemental type certificate (STC) may require airplane flight manual (AFM) update.
(2) Removal by administrative control process; e.g., logbook entry.
(3) Connectivity wired or wireless.

[f] AIR & AEG Involvement:
(1) Requires system power, data connectivity, & mounting devices evaluation by AEG and AIR design approval. AIR design approval limited to airworthiness approval of mounting device, crashworthiness, data connectivity and power connections. In some cases AIR design approval may not be required. AIR ensures non-interference with and isolation from aircraft systems during transmission and reception.
(2) AEG documents non-interference compliance per current AC 91.21-1.
(3) AIR and/or AEG conduct human factors and operational evaluations of mounting device and flight deck location.

[g] Operator Requirements:
(1) Ensures system performs its intended function.
(2) See item (2) in footnote [c].
(3) Determines usage of hardware architectural features, persons, procedures, and equipment to eliminate, reduce, or control risks associated with a hardware identified failure.



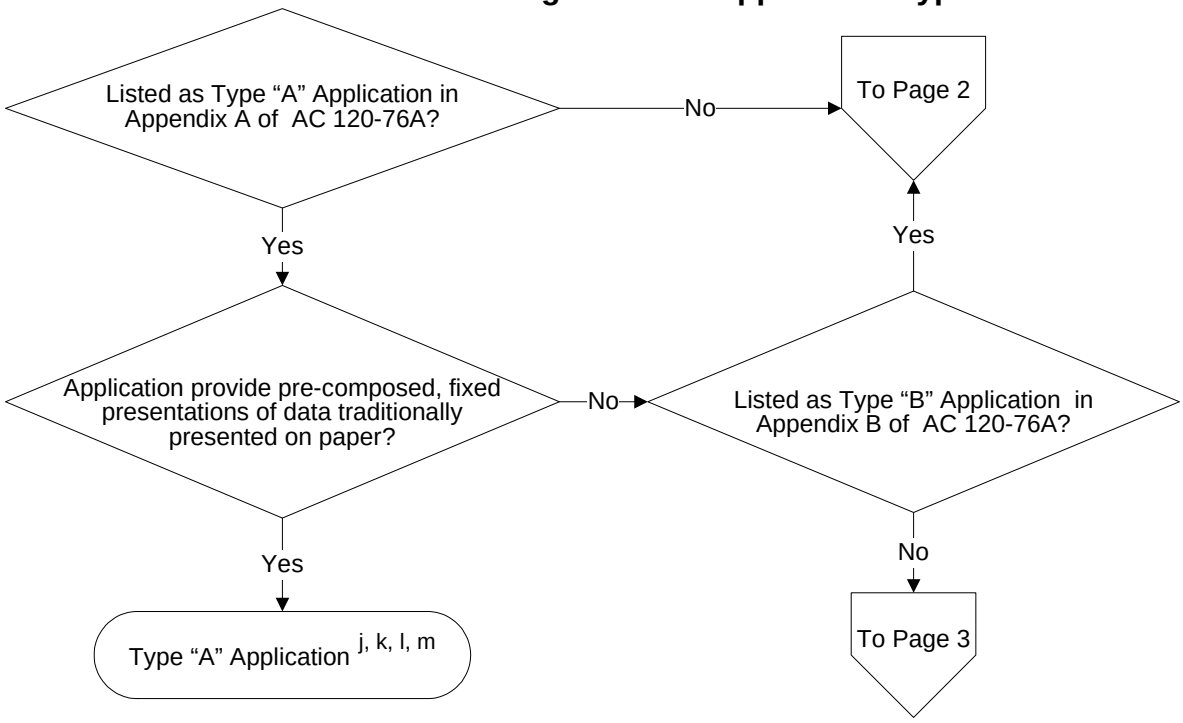
[h] Class 3 EFB Hardware: Requires compliance with DO-160D/E Environmental Conditions and Test Procedures.

[i] AIR & AEG Involvement:

(1) AIR evaluates and approves the design of all Class 3 EFB Hardware.
(2) AIR issues EFB TSO/STC.
(3) AEG evaluation includes Operations/Maintenance acceptance, approval, and inclusion in an FSB Report.
(4) AIR and AEG perform all other applicable tests, evaluations, and actions that would be performed for EFB Class 2 Hardware.

APPENDIX 3

Flow Chart for Determining Software Application Type

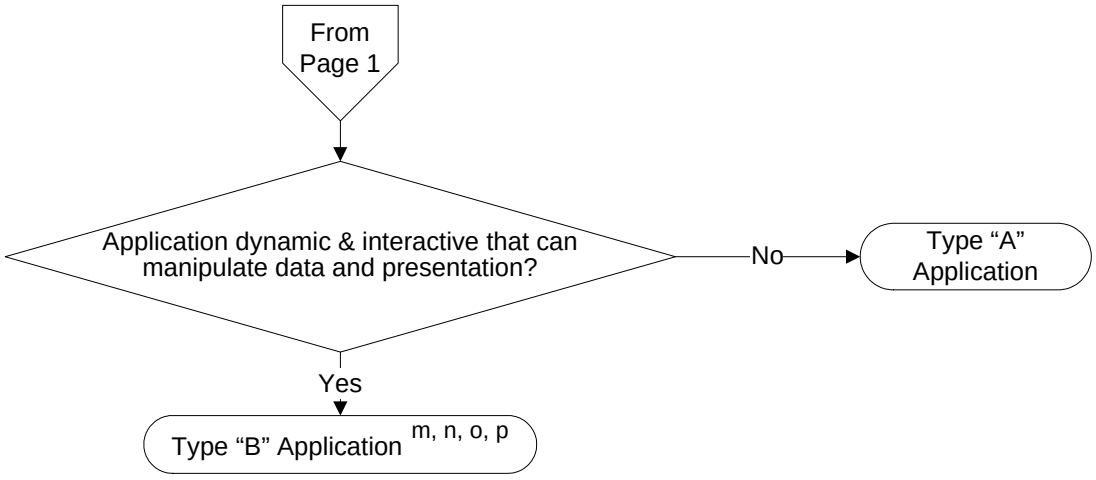


[j] Type "A" Applications: may be hosted on any hardware class; require FSDO and PI approval; do not require AIR design approval or compliance with RTCA/DO-178B; require a 6-month operational evaluation during which the operator must use both the EFB system and the conventional system; and require the operator to report the results of the operational evaluation to the POI before final approval.

[k] Aircraft Certification (AIR) & Aircraft Evaluation Group (AEG) Involvement: NONE.

[l] Operator Requirements: (1) Determines usage, architectural features, people, procedures, and equipment to eliminate, reduce, or control risks associated with an identified failure in a system. (2) Provides evidence to the POI that: (a) the EFB operating system and hosted application software meet the criteria for the appropriate intended function and do not provide false or hazardously misleading information; (b) loading software revisions won't corrupt data integrity of original software when first installed and "baselined;" and the EFB performs its intended function; and (3) Performs 6-month operational evaluation during which both EFB and conventional system are used and reports to the POI.

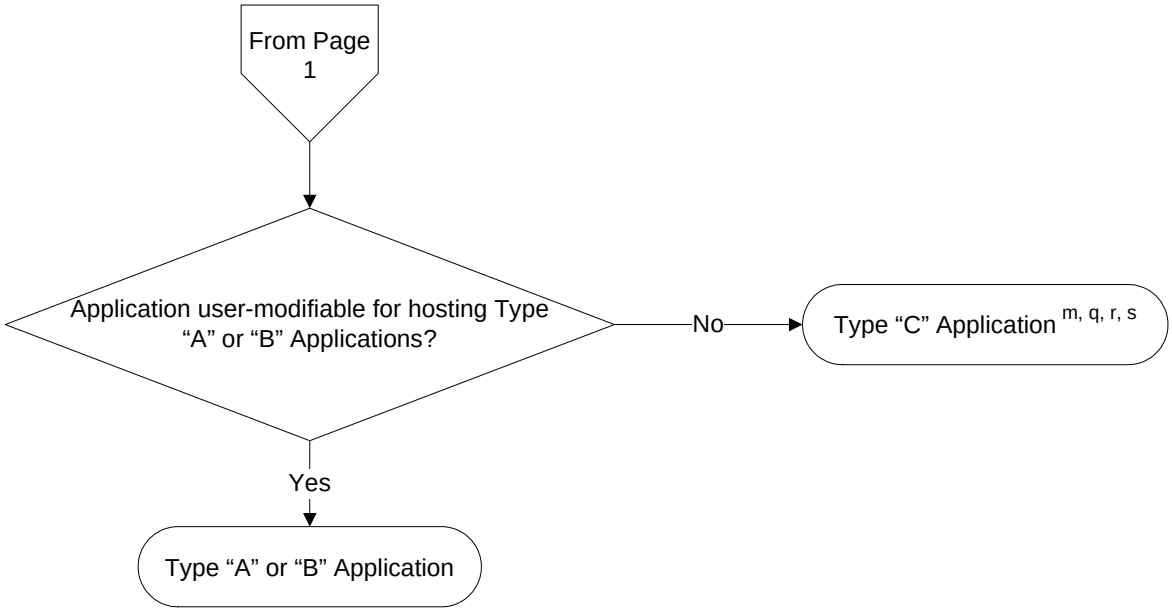
[m] Principal Inspector (PI) Involvement: Verifies that (1) application criteria & operator requirements are met; (2) data updates follow maintenance manual and inspection program procedures; (3) applicable job aids, including human factors evaluation, are completed; (4) coordination with AIR and AEG for appropriate approvals and reports is accomplished; (5) training, checking, and currency programs are approved; (6) authority is granted for 6-month operational evaluation in Mspec or OpSpec (A025); (7) operational evaluation report from operator is appropriately reviewed; and (7) Mspec or OpSpec (A025) is issued upon completion of approval process.



[n] Type "B" Applications: (1) may be hosted on any hardware class; require FSDO and PI approval; do not require AIR design approval but require AEG evaluation and inclusion in an FSB Report; are not required to comply with RTCA/DO-178B; require 6-month operational evaluation during which operator must use both the EFB system and the conventional system; require operator to report the results of the operational evaluation to the POI prior to final approval; may be used to display pre-composed information such as navigation or approach charts; required flight information should be presented for each applicable phase of flight; pending AEG/human factors evaluation, panning, scrolling, zooming, rotating, or other active manipulation is permissible; electronic navigation charts should provide a level of information integrity equivalent to paper charts; additional Type B applications may require TSO approval. (2) Flight Standards (AFS) initial operational approval granted for hosted performance applications based on AEG recommendations to include flightcrew training, checking & currency requirements per draft FSB Report. (3) Hosted Interactive Performance/Weight and Balance Applications should meet the following criteria: (a) Operational procedures should be developed per 121.133. These procedures should define the roles that the flight crew and dispatch/flight-following have in creating, reviewing, and using performance calculations supported by EFBs; (b) Its baseline software programs and functions must be evaluated by the AEG; (c) FAA approval is based on the operator's EFB training and procedures, the AEG recommendation, and the FSB Report; (d) Authorization for use is placed in OpSpec A025; and (e) OpSpec E096, Weight and Balance Control Procedures, lists EFB in approved method for weight & balance calculation.

[o] AIR and AEG Involvement: (1) No AIR design approval is required - AEG evaluation is required. (2) AEG recommendations include flightcrew training, checking, and currency requirements per the draft Flight Standardization Board (FSB) Report. (3) AEG with the POI reviews the 6-month operator evaluation final report and if appropriate, grants final approval through the FSB Report.

[p] Operator Requirements: Demonstrates the EFB meets operational & certification requirements: (1) Usage of application architectural features, persons, procedures, and equipment to eliminate, reduce, or control risks associated with an identified failure in a system; (2) Performs 6-month operational evaluation per authority granted in OpSpec/MSpec A025; (3) Ensures FSB evaluation is complete if seeking reduction in 6-month period before contacting AFS-200; (4) Carries both EFB system and paper copies during evaluation period; (5) Submits final report to POI and AEG after evaluation; (6) Operating system and hosted application software meet criteria for appropriate intended functions and do not provide false or hazardously misleading information; (7) Software revisions will not corrupt data integrity of original application version when first installed & "baselined."



q Type "C" Applications:
(1) Primary flight displays are examples of Type "C" Applications.
(2) A means for obtaining AIR design approval is a Technical Standard Order Authorization (TSOA), which is a dual FAA certification design and production approval with a streamlined approval process.
(3) An index of TSO standards is published in the current version of AC 20-110, Index of Aviation Technical Standards Orders.
(4) The regulatory basis for a TSOA is defined in 14 CFR part 21, subpart O.
(5) Type "C" Applications that receive a TSOA may be approved for use as EFB Class 1 and 2 systems provided they meet the following conditions:
a. Hosted Applications must be classified as a minor failure effect or no safety effect. No major safety effect or higher classifications are acceptable.
b. Type "A" and "B" Applications may reside in a TSOA system provided they do not interfere with any Type "C" Application.

r AIR & AEG Involvement:
(1) AIR design approval required, except for user modifiable software, which may be utilized to host Type "A" and "B" Applications. No user modifiable application may effect any Type "C" Application. RTCA/DO-178B describes user modifiable application.
(2) Type "A" and "B" Applications do not require AIR design approval, but a Type "B" Application requires PI/AEG approval.

s Operator Requirements:
(1) Applies for a TSOA for certain Type "C" Applications.
(2) Follows current airworthiness and operational approval process.

APPENDIX 4

Information for an Application and Sample Requests

As part of Phase 2, the applicant must submit an application letter (see below) to the FSDO or CMO having certificate management responsibility. This type of information should be provided if an AEG review is required.

The application letter should include at least the following information:

1) A general description of the EFB system, including:
   a) EFB manufacturer
   b) EFB model
   c) A description of major components within the EFB, such as:
      i) Processor
      ii) Video Card
      iii) Hard Drive
      iv) Wireless Connection
      v) Power Supply
      vi) RAM
   d) The EFB operating system and version
2) A list of the applications to be installed.
3) For each application, include a high-level description of revision process, procedure, or method that ensures appropriate database accuracy and currency. The manufacturer's name and model number of the mounting system (if applicable).
4) Aircraft Make/Model/Series
5) Any manufacturer's data available for:
   a) Electromagnetic Interference (EMI)
   b) Rapid Depressurization, if applicable (see AC 120-76A, Paragraph 11 (d), p. 16)

FIGURE 1. Example Application Letter Class I, Type A

March 15, 2005

Principal Operations Inspector

Flight Standards District Office
300 Lindberg Drive
Tulsa, Oklahoma 57692

Dear Sir:

All Friendly Aviation, Inc. hereby makes application in accordance with AC 120-76A for approval in our Operations Specifications to conduct operations on our B-737-200A using the FlyLab 1030 Flight Deck Electronic Flight Bag.

The FlyLab 1030FDEFB is a self contained COTS computer manufactured by Fly By the Seat of Your Pants, LLC, located in New York City, NY. Please refer to the attached FBSYP Document 1030-001-8907 for a description of the major components and specifications of the system. The document also contains the manufacturer's EMI and decompression data.

All Friendly Aviation, Inc. intends to conduct flight operations using the EFB as a Class 1 device with Type A applications as described in the AC. The intent is for flight crews to have access to the following company manuals in Adobe® Portable Document Format (PDF); FCOM, Emergency Procedures Manual, Approved Weight and Balance Manual, Minimum Equipment List, Dispatch Deviations Guide, and Approved Flight Manual (AFM). The manuals are maintained by the Director of Operations and converted to .PDF for uploading on the EFBs as revisions are accepted or approved.
We intend to commence flight operations using the EFB on or about June 1, 2005.

Sincerely,

Smith Ballon
President

Enclosure

FIGURE 2. Example Application Letter Class II, Type B

March 15, 2005

Principal Operations Inspector

Flight Standards District Office
300 Lindberg Drive
Tulsa, Oklahoma 57692

Dear Sir:

All Friendly Aviation, Inc. hereby makes application in accordance with AC 120-76A for approval in our Operations Specifications to conduct operations on our B-737-200A using the FlyLab 1030 Flight Deck Electronic Flight Bag.

The FlyLab 1030FDEFB is a self contained COTS computer manufactured by Fly By the Seat of Your Pants, LLC, located in New York City, NY. Please refer to the attached FBSYP Document 1030-001-8907 for a description of the major components and specifications of the system. The document also contains the manufacturer's EMI and decompression data.

All Friendly Aviation, Inc. intends to conduct flight operations using the EFB as a Class 2 device with Type A and Type B applications as described in the AC. The intent is for flight crews to have access to the following company manuals in Adobe® Portable Document Format (PDF); FCOM, Emergency Procedures Manual, Approved Weight and Balance Manual, Minimum Equipment List, Dispatch Deviations Guide, and Approved Flight Manual (AFM). We also intend to use JeppView™ for departure and arrival operations. The manuals are maintained by the Director of Operations and converted to .PDF for uploading on the EFBs as revisions are accepted or approved. We will maintain a contract with Jeppesen, Inc. for chart subscription.

We have contracted with XYZ Aircraft Parts Unlimited for application of an STC to mount the EFB on both the Captain's and First Officer's positions.

We intend to commence flight operations using the EFB on or about June 1, 2005.

Sincerely,

Smith Ballon
President

Enclosure

APPENDIX 5

EFB Line-Operations Evaluation Job Aid

This tool provides a starting point for EFB line-operations evaluations by the FAA inspector and operator. The questions are designed to collect a structured set of observations about use of the EFB before or during the 6-month operational evaluation. Use of this tool can be customized as appropriate for the situation.

The questions below encompass the operations and safety related functions that a Principal Inspector (PI) would normally evaluate. System complexity, software applications, mounting method, or type of in-flight use may dictate more in-depth evaluations. In cases where the FAA team finds that a system shows weaknesses or limitations, mitigations should be developed in consultation with the applicant.

In some cases an EFB may add to the complexity of flight operations. The key questions to be answered are:

1) Can the flight be conducted as safely with an EFB as with the methods/products it is intended to replace?

2) Does the EFB add an <u>unacceptable</u> level of complexity for any critical activity or phase of flight?

In order to answer these high-level questions, it is helpful to consider more specific aspects of EFB usage, which are covered in Sections II through V below. Space is also provided in Section I to record general notes about the system and the evaluation.

I. Evaluator Notes. (e.g., system description, flight conditions)

II. Overview. The main aspects to be assessed are encompassed by the following questions:

1. Was training adequate to ensure that the pilot(s) could perform in a safe and efficient manner? _____
   - Were individual pilot knowledge and skills adequate to allow normal coordinated cockpit activities? _____
   - Was pilot knowledge regarding observed software applications adequate? _____
2. Are adequate procedures in place to ensure that the EFB is integrated into the operator's system (e.g., normal and abnormal/emergency operations and maintenance functions)? _____
3. Were there any system hardware or software inadequacies during the flight that created a significant problem, particularly in a critical phase of flight? _____
   - Could the pilot(s) recover from usage errors without undue distraction or discussions? _____
   - Were usage errors frequent? Describe: _____
4. Was the workload required for completing a task with the EFB equal to or less than the workload for completing the task with the conventional method? _____
   - If no, specify phase of flight and task for any marginal or unacceptable increases in workload _____
   - Is the overall EFB workload acceptable? _____

III. General

1. Hardware (physical dimensions, input devices, display quality, arrangement/accessibility of controls, etc.):
   - Was each pilot able to use the cursor, track ball, touch screen, etc. for menu and functionality without frequent errors? _____
   - Did any environmental factors (e.g., turbulence, cold weather, vibration) impact use of the EFB? _____
   - Were there significant limitations viewing the display (e.g., at off-axis angles, or under different lighting conditions)? _____
   - Was a screen or display ever misinterpreted because of viewing limitations? _____
   - Is screen brightness or background cockpit lighting an issue (e.g., at nighttime)? _____
   - Did the pilot(s) ensure proper installation and security (i.e. between flights, etc.) of EFB per SOP? _____
   - Are procedures for physical installation and security adequate? _____

- Does the display continue to be usable after prolonged use in the flight deck environment (if applicable)? _____

2. Did normal functions (e.g. shut down, start up, etc.) require undue pilot attention or concern? _____
3. Were procedures adequate for identifying currency of EFB data? _____
4. Could the pilot(s) easily find and use required items and functions? _____
5. Did the pilot(s) have difficulty understanding abbreviations or icons? _____
6. If multiple applications are supported, was there more than one critical application or function needed on an EFB at the same time and could the pilot(s) easily switch between critical applications? _____
7. Where critical items are approved (e.g., abnormal or emergency checklists) is their use at least equal to or better than previously approved methods? _____
8. Did the pilot(s) take too much time to complete normal tasks? _____
9. If audio is available, did it cause any pilot distraction? _____

IV. Electronic Charts, Documents, and Checklists

10. Were all necessary documents (including charts, checklists, and manuals) found, identified, and easily viewed by the pilot(s) without undue distraction? _____
11. Was information contained in electronic charts, documents, and checklists complete, equal in quality to previously provided products, and easily accessible and understandable? _____
12. Was pilot knowledge of chart/document/checklist selection and viewing adequate? _____
13. Could the pilot(s) easily rearrange content on the screen to meet needs (e.g., by zooming, panning, or otherwise customizing the view)? _____
14. If printers are used, are printouts acceptable? _____
15. Were all required charts, documents, and checklists available during flight? _____
16. Was legibility and accessibility of information on charts, documents, and checklists acceptable? _____
17. Are all aspects of functionality (i.e. pan, zoom, scroll, etc.) adequate and intuitive during flight? _____
18. For electronic charts:
    - Did the pilot(s) exhibit adequate knowledge of EFB functions to efficiently brief and fly required procedures? _____
    - Were both pilots able to monitor necessary electronic chart displays during critical phases of flight? _____
    - Did the system allow quick entry of updates for last minute changes (e.g., flight plan/runway changes)? _____
19. For electronic checklists, was there difficulty in tracking completed items? _____

V. Flight Performance Data/Calculations

20. Could the pilot(s) interpret and use flight performance data/calculations efficiently and accurately? _____
21. Did the system allow quick entry of updates for last minute changes (e.g., flight plan/runway changes)? _____

VI. General Conclusions

Were any unique safety issues or events caused or exacerbated by using the EFB during this evaluation? _____

Can the flight be conducted as safely with an EFB as with the methods/products it is intended to replace? _____

Does the EFB add an unacceptable level of complexity for any critical activity or phase of flight? _____

APPENDIX 6

Guide for Developing Simulator and Validation Flight Scenarios

Simulator and/or in-flight validation tests may be needed to fully determine the suitability of an EFB (see AC 120-76A Paragraph 12 (j), pp. 21-22). The following event-based scenarios may be helpful in constructing EFB validation scenarios. The examples below are only generic suggestions; each operator's proposed EFB functionality and software will vary and scenarios should be customized for the particular situation by the inspector and applicant.

Where appropriate, some of the tests could be conducted as part of the operator's 6-month field test of the EFB. If the operator has approved line operational scenarios, the EFB could be integrated into these existing scenarios to provide a basis for evaluation. Some of the suggested simulated emergency procedures may only be appropriate in a simulator or training device. The most appropriate means for the validation should be determined together by the inspector and applicant.

At the end of the validation flight(s), it should be evident that, as applicable, information provided by the EFB is at least equal to that obtained from pre-EFB methods.

Scenarios

The validation flight scenarios should be used to ensure that EFB use has been adequately transitioned into the operator's overall training and operations programs. The scenarios should not be combined so as to overload an individual pilot or crew. Note that the tasks below do not specify how the EFB will be used in detail; they merely specify what the crew must accomplish. In some cases, the task will be completed entirely with an EFB, and in other cases, the EFB may be used together with other sources of information (e.g., paper charts or documents), depending on the capabilities of the EFB and its operational implementation.

Six classes of scenarios are presented below, based on the phase of flight.

a. Preflight planning. Observe crew actions and EFB use in preparing for the flight (e.g., in calculating aircraft weight and balance, takeoff, climb and maneuvering speeds).

- Compare values from the EFB with values computed from previously approved methods. Check at least three samples throughout the range of performance (i.e., minimum to maximum).
- Observe how the pilot/crew maintains critical data for immediate reference (e.g., fuel quantity, "V speeds", etc.).
- During taxi, introduce a runway change and, if an EFB is used for critical aircraft system information, initiate the need to reference one or more applicable items such as an airframe deicing fluid requirement, MEL item, etc.
- Introduce time critical adjustments prior to block out/taxi and takeoff (e.g., fuel, passenger load, etc.).

b. Takeoff. Observe crew actions and EFB use during several types of departures.

- Combine a complex Standard Instrument Departure (SID) or Departure Procedure (DP) with an abnormal or emergency event during the departure climb-out.
- Establish take-off on a runway that requires recognition/briefing special operator engine-out procedure (if applicable).
- Introduce an engine failure or other significant emergency that requires a return to the departure or alternate departure airport.
- On takeoff roll, observe actions taken when all EFB screens fail ("blank out") prior to V1 (or rotation, as applicable).
- Immediately after takeoff, observe actions taken when all EFB screens fail ("blank out"), or when one of two EFBs fail, requiring one pilot to rely on the EFB of the other pilot.

c. Level-off/Cruise. Observe crew actions and EFB use during abnormal situations in cruise.

- Initiate an engine-failure/fire with possible condition of destination below weather minimums. (If applicable, require drift down solution.)
- Initiate electrical smoke in the cockpit requiring use of smoke mask/goggles while completing checklists, using EFB for approach briefing, etc.
- Initiate abnormal condition requiring EFB for reference of MEL or other procedural guidance (as applicable).
- If cabin crew interact with the flight crew through EFB in anyway, introduce an abnormal situation, medical emergency, maintenance item, etc. (These could be added to any other flight phase scenario, if applicable.)

d. Descent. Observe crew actions and EFB use during preparation for landing.

- During approach to landing, introduce a runway change, holding, and/or the need to re-compute landing weight and V speeds.
- During descent, tell the crew that reported runway conditions require reference to operational limitations due to contamination, wind, etc.

e. Approach/Landing Observe crew actions and EFB use under poor weather conditions, or to airports with complex taxi routes.

- During approach/landing, tell the crew that conditions require reference to SMGCS taxi routing or a complex clearance.
- Initiate an ATC request for specific taxiway turn off during rollout after landing.

f. Destination Ground Operations: Observe crew actions and EFB use during ground operations.

- Initiate EFB partial failure or simulate possible erroneous output requiring maintenance discrepancy to be entered.

Expanded Sample Scenarios

The EFB validation-flight scenarios given above could be affected by different factors, such as:

- Software: Type of EFB software application(s) (Type A, B, or C)
- Hardware: Class of EFB hardware (Class 1, 2, or 3), which includes factors such as location in the flight deck, and connectivity to other aircraft systems.
- Aircraft/Operations: Type of aircraft and operations (e.g., single pilot vs. dual pilot, single EFB vs. dual EFB)
- Weather: Weather conditions (e.g., visual vs. instrument, or very low visibility)

The four examples below illustrate how these factors could affect the use of the EFB in more detail. In each example, various conditions are assumed, and consequences for the EFB evaluation are explored.

a. Preflight Planning. Observe how pilot/crew maintains *V speeds* for immediate reference. In particular, V speeds must be visible and directly in front of the crews during takeoff (regardless of the type of operation).

- Software: Assume Flight Performance calculations, a Type B application
- Hardware: Class 1 and 2 EFBs are generally not located directly in front of the pilot during takeoff. Therefore, V speed calculations completed on Class 1 or 2 EFBs would need to be transferred from the EFB (e.g., onto a display bug, or piece of paper) and placed in the pilot's forward field of view for takeoff. A Class 3 EFB may have communication capabilities so that V speeds calculated on the EFB could be transferred electronically to displays that are directly in front of the crew.
- Aircraft/Operations: This task applies to all operations.
- Weather: Performance of this task would not vary with weather.

b. Takeoff. Assume that the EFB is displaying an electronic chart during takeoff. The EFB goes blank prior to V1 (or rotation, as applicable).

- Software: Assume Type B (Interactive) Electronic charts application
- Hardware: A Class 1 EFB cannot be in use during takeoff, and so this example applies only to Class 2 and 3 EFBs.
- Aircraft/Operations: This task is applicable to all aircraft/operation during takeoff.
- Weather: In visual flight conditions, the pilot could continue the takeoff without the information provided by the EFB. In low visibility or instrument conditions, considerations should be given to returning to the field or diverting to an alternate airport.

c. Level-off/Cruise. Initiate a diversion to a destination that is below weather minimums. The diversion could be caused by weather, a maintenance issue, or an emergency, such as an engine-failure/fire.

- Software: Could have electronic checklists, electronic charts, electronic documents, or any combination of these on the EFB. The electronic checklists may or may not include emergency checklists. The applications could share information between them, or be completely independent from one another.
- Hardware: EFB could be of any hardware class. Single or dual EFBs could be present. If there are dual EFBs, they could be independent so that the pilot-flying and the pilot-non-flying could refer to different information.
- Aircraft/Operations: In a single-pilot, single-EFB condition, it would be difficult to use an EFB effectively to manage an emergency situation. In a dual-crew, dual-EFB, Class 3 system with fully integrated electronic emergency checklists, the EFB could make an emergency situation easier to handle.
- Weather: During turbulence, managing the EFB could be more difficult. Depending on the weather, alternate approach procedures may need to be considered, implying heavy use of an electronic chart application.

d. Descent/Approach/Landing During descent into an airport experiencing low visibility conditions, the pilot/crew needs to access information about operational limitations. During approach/landing into the field, conditions require reference to SMGCS (low visibility) taxi routing or a complex clearance.

- Software Application(s): Assume Type B (Interactive) Electronic charts application. Relevant documents could also be available on the EFB.
- Hardware: EFB could be of any hardware class. Although Class 1 hardware is generally not permitted to be used at low altitudes, it could be used during the beginning of the descent, and during surface operations.
- Aircraft/Operations: This scenario is applicable for evaluating EFB use by airlines landing at airports with SMGCS routes. (CAT II and III conditions require special ground routes, equipment, and charts.) The SMGCS procedure could be displayed on an EFB in an electronic chart application. Because these charts show complex taxi routes, the crew may need to zoom in and out of the chart often to maintain a view of the route, implying increased workload (in an already difficult situation). The SMGCS procedures may also need to be in the pilot's primary field of view. This could be a difficult scenario for a single pilot who is using a Class 1 EFB.
- Weather: Reported runway conditions could require reference to documents to obtain information about operational limitations due to contamination, wind, etc. during descent. Turbulence during the descent/approach could also affect use of the EFB.

APPENDIX 7

Operational Evaluation Questions

This appendix contains a comprehensive list of questions for consideration during a “desk-top” EFB evaluation (i.e., an evaluation conducted outside the context of a simulated or actual flight). The questions are designed to promote a thoughtful structured exploration and review of the EFB system from a human factors perspective. In cases where the FAA team finds that a system shows weaknesses or limitations, or where the FAA team simply cannot predict how well the system will perform, mitigations should be developed in consultation with the applicant.

These questions are intended to address a wide variety of operators/equipment. The FAA inspection team should customize its use of these questions. For example, for simple EFBs (e.g., Class I, Type A), certain questions may not be applicable in the view of the FAA inspection team. Some questions have sub-items, which could be questions or considerations that clarify and expand upon the primary question, but some sub-items may not be applicable to the specific situation.

The appendix is divided into three subsections. The first, Section A, covers general operational evaluation questions. This section is for use by *both* the Aircraft Evaluation Group (AEG)/Aviation Safety Inspector (ASI), and the Flight Standards District Office (FSDO)/Principal Inspector (PI). Within Section A, there are five main sections:

1 General EFB System
2 Electronic Documents
3 Electronic Checklist Systems (ECL)
4 Flight Performance Calculations
5 Electronic Charts

Of these five main sections, the first (General EFB System) is the largest. Within this large section, topics are further subdivided into the following sections: General Considerations, Physical Placement, Training/Procedures Considerations, Software Considerations, and Hardware Considerations.

The second part of this appendix, Section B, includes additional questions that are appropriate during an evaluation by the AEG/ASI. In general, questions that are specific to the AEG/ASI are related to initial installations and training for a given aircraft. Some of the AEG/ASI questions provide for a more thorough evaluation, appropriate for EFBs that will be used in a more complex manner. For example, this section contains detailed questions on applications such as Electronic Charts, Flight Performance Calculations, and Electronic Checklists. Section B is not intended for use by the FSDO/PI.

The last part of this appendix, Section C, contains additional questions that are appropriate during an evaluation by the FSDO/PI. Questions that are specific to the FSDO/PI are generally related to documentation and long-term use of the EFB (e.g., during the 6-month operational evaluation). Questions in Section C are not appropriate for the AEG/ASI.

A. General Operational Evaluation Questions

This section covers general operational evaluation questions for an EFB system. This section is for use by both the Aircraft Evaluation Group (AEG)/Aviation Safety Inspector (ASI), and the Flight Standards District Office (FSDO)/Principal Inspector (PI). This section is divided into the following subsections: General Considerations, Physical Placement, Training/Procedures Considerations, Software Considerations, and Hardware Considerations.

GENERAL EFB SYSTEM

General Considerations

Workload

See also 0.1 in Section B (p. 13).

a) How does the workload required for completing a task with the EFB compare with the workload for completing the task with a conventional method?

If there is an increase in the workload of completing a task with the EFB relative to alternative methods, is this increase acceptable?

b) Are additional policies or procedures required to safely accommodate the EFB?

What are they?

Are they adequate?

c) Is there any impact to crew workload from an EFB failure?

If yes, is the impact acceptable?

d) Are there any aircraft system failure procedures (i.e. electrical smoke, fire, etc.) that could render the EFB unusable?

If yes, is this incorporated into procedures, checklists, etc.?

Using EFBs During High Workload Phases of Flight

1. Does the use of the EFB impose additional workload during a high workload phase of flight?

   For example, are complex, multi-step data entry tasks avoided during takeoff, landing, and other high workload phases of flight?

   Do company procedures mitigate workload issues?

2. If the EFB is designed for use during high workload phases of flight (including takeoff and landing), is it secured within the aircraft?
3. Are additional policies or procedures required to safely accommodate the EFB in high workload phases of flight (e.g., must approach briefings be accomplished earlier en route, restrictions placed on multi-function use, etc.)?

   What are they?

   Are they adequate?

   Are they included in pilot/crewmember training?

4. Are there procedures, policies, or built-in limits on use of the EFB to ensure that pilots do not become distracted during high workload phases of flight?

Keeping EFB Content/Databases Current and Ensuring Integrity of EFB Data

a) *For each of the applications* on the EFB, what are the *procedures* for keeping the databases/stored data accurate, current, complete, and uncorrupted?

Who modifies the content/databases and how?

How are changes to content/databases documented?

How are crews notified of updates?

If any applications use information that is specific to the airplane type or tail number, are there procedures to ensure that the correct information is installed on each airplane?

Are operational control procedures consistent with regulations concerning preventative maintenance?

b) What procedures are in place to avoid corruption/errors during changes to the EFB system?

c) If there are multiple EFBs on the flight deck, are their procedures to ensure that they all have the same content/databases installed?

Compatibility and Consistency with Flight Deck Systems and Other Flight Information

d) Are there any noticeable conflicts between the EFB and flight deck interfaces, or is the user interface of the EFB generally compatible with the flight deck? (In order to be "compatible," the EFB user interface should not be in direct conflict with other systems.)

If there are conflicts between the EFB and flight deck interfaces, how significant are they? Is the user EFB interface still acceptable?

e) Does the EFB minimize the potential for crew error by using terms, icons, color codes, and symbols that are consistent with flight deck systems and other sources of flight information? Note that, in order to be "consistent", the EFB user interface should match the other systems.

Use of the EFB with Other Flight Deck Systems

f) Are there procedures to ensure that the crew knows what flight deck system information is to be used if there is any redundancy with the information from *any application* on the EFB?

For example, if the EFB computes data that the FMS also computes, which is primary?

What are the procedures for establishing which source of information is primary?

g) What procedures does the crew follow if there is a disagreement between the EFB and other flight deck systems, or between multiple EFBs?

h) Is a backup source of information necessary?

Under what conditions will the backup source of information be used?

What are the consequences of using backup information?

Lighting Iss*u*es

i) Can the EFB screen be read under a variety of typical flight-deck lighting conditions?

If no, what mitigations are available for making it possible to read the EFB screen? Are these mitigations acceptable?

j) If the EFB is to be used outside the flight deck, can the EFB screen be read under outdoor lighting conditions?

k) Can the user adjust the screen brightness and contrast?

Does the EFB adjust screen brightness automatically, and if so, is the adjustment acceptable?

l) Are buttons and labels adequately illuminated for all environmental conditions (e.g., day, night, weather)?

m) If predetermined settings for illumination are required, are they incorporated in pilot procedures, or checklists?

System Shutdown

n) Are unique procedures for shutting down the EFB necessary (e.g., over and above normal aircraft parking/shutdown)?

What are they?

Are they designed for long-term stability of the EFB and ease of crew operation?

What happens if the crew cuts power to the EFB instead of shutting it down properly?

Are previous users' data entries cleared upon shutdown so that the system starts up in a predictable state?

o) Does the EFB function correctly when rebooted?

Failures

p) What are the failure modes for the hardware and software?

How does each type of failure affect crew and/or aircraft operations?

Should there be any MMEL/MEL items to handle these failures?

q) Are failures obvious to the crew?

Is the nature of the failure clear?

r) Are failures handled with minimum impact to crew tasks and workload?

Are there special EFB checklist failure items that must be incorporated into FAA approved checklists?

s) Are there procedures in place for the crew in case a failure occurs?

If the EFB “hangs”, fails to respond to crew input, or displays error or fault messages, are the means of recovery easy to remember and apply?

Does the crew have to remember any arbitrary procedures or refer to paper documentation in order to restart the EFB?

Physical Placement

Stowage Area

t) Is there a stowage area for the EFB? When the EFB is not stowed, is the securing mechanism in the stowage area unobtrusive?

u) When the device is stowed, does the combination of it and the securing mechanism intrude into any other flight deck spaces, causing either visual or physical obstruction of important flight controls/displays and/or egress routes?

v) Is the design of the stowage area acceptable?

Does movement of the EFB to and from a stowage area require substantial effort, or substantially limit access to flight displays and controls?

Is the securing mechanism simple to operate for a wide population of users?

Are the device and/or the stowage area easily damaged under normal usage?

Use of Unsecured EFBs (includes Operations Procedures under MEL)

w) Does the pilot have adequate access to flight controls and displays when the unsecured EFB is in use?

x) Is there an acceptable place to put an unsecured EFB when in use?

y) Is there an acceptable place to put an unsecured EFB when not in use?

Kneeboard EFBs

Note: The AEG would only evaluate kneeboard EFBs if a Type B application is supported.

z) Can the kneeboard EFB be positioned such that the pilot has full control authority?

aa) Is the kneeboard EFB comfortable for the pilot to wear under normal conditions?

bb) Are there special procedures in place for removal of the EFB during emergency landing or egress?

Design and Placement of Structural Cradle

See 0.4 in Section B (p. 13).

Training/Procedures Considerations

Training on Using EFB Applications

Is there a training program on how to display and interact with each of the individual applications (e.g., electronic documents, electronic charts, or electronic checklists)? Is it adequate?

Do crews understand how to use any new or unique features of the electronic applications (e.g., do crews know how to use electronic document functions that do not exist for paper documents, such as hyperlinks and search)? Note: For Part 91 operators, refer to FAA Industry Training Standards (FITS) program.

Operations EFB Documentation and Policy

See also 0.2 in Section C (p. 18).

cc) Is the documentation provided by the manufacturer with the EFB sufficient?

dd) Are adequate MMEL/MEL items for the EFB in the manual?

EFB Training

See 0.3 in Section B (p. 13), and 0.3 in Section C (p. 18).

Fidelity of EFB Training Device

Is the actual EFB used during training? If not, does the substitute EFB (training device) provide an adequate degree of fidelity?

Does the training device simulate the key aspects of the task?

User Feedback

See 0.5 in Section C (p. 18).

Software Considerations

User Interface—General Design

See also 1.4.1 in Section B (p. 13).

ee) Is the organization of the software adequate?

For example, are the user interface, functions, function labels, and functional and navigation logic consistent with established user interface conventions for similar systems?

Is any information expected by the crews missing or in a different place?

ff) Was the layout of information on the screens adequate?

For example, are similar or related fields, indicators, or controls located near each other? Are controls separated adequately if using the wrong one unintentionally has significant consequences?

gg) Are common actions and time-critical functions easy to access?

General Use of Colors

See also 1.4.2 in Section B (p. 13)

hh) Are red and amber/yellow used? If so, are they used appropriately? Red should be used only for warnings and amber/yellow only for cautions.

ii) If multiple colors are used, can they all be seen and distinguished under the various lighting conditions in which the EFB will be used?

jj) If colors can be customized, are there procedures or built-in limits that prevent defining color schemes that conflict with flight deck color conventions?

Symbols and Icons

kk) Are symbols (e.g., graphical objects on an electronic chart) and icons (graphical controls) clearly depicted on the screen in all viewing conditions? That is, are the symbols and icons legible?

Are their functions obvious?

Are the symbols and icons distinguishable from one another?

ll) Are any icons confusing? Is training necessary to ensure that the icons are understood? (Icons are software-implemented controls that are represented on the screen by graphical pictures of limited size and resolution.)

Does the initial EFB training adequately address icon meanings?

Does the system provide information that explains each icon's meaning (e.g., a text label)?

mm) Are the EFB icons and symbols compatible with those depicted on paper equivalents?

Legibility of Text—Characters, Typeface, Size, Width, and Spacing

Is the text easily readable?

Do the characters stand out against the screen background?

Are upper case and italic text used infrequently?

Are the characters sufficiently large for normal viewing conditions?

Is information that will be used in low-visibility conditions (e.g., emergency checklists) presented in text that is especially large and easy to read?

If the text is too small to be read easily, it is it easy to zoom in on it to make it legible?

Is the spacing between characters appropriate?

Is the vertical spacing between lines appropriate?

Multi-Tasking

nn) Is it easy to tell which application is currently open?

oo) Can the pilot switch between applications easily?

pp) Is an extra acknowledgement required to open applications that are not flight related?

qq) Do all applications that are open at the same time function as intended on an individual basis?

Responsiveness

rr) Does the system respond immediately to user inputs, e.g., by providing feedback?

If processing is delayed, are busy indicators and/or progress indicators displayed?

Are the indicators clear and useful to the pilot?

ss) Does the system processing ever slow down to the point where normal use is impaired?

Alerts and Reminders

See 0.7 in Section B (p. 13).

Display of System Status

See 0.8 in Section B (p. 13).

Supplemental Audio and Video

Does the EFB support audio and/or video that are not associated with alerts, cautions or other critical system information? If yes,

Does the operator have a policy regarding the use of this "supplemental" audio and/or video in flight?

Does the user have control over when, and whether, the audio and/or video is activated?

Is the audio audible in flight?

Does the audio interfere with higher priority aural tasks (e.g., communications)?

Crew Confirmation of EFB Software/Database Approval

Is there a procedure for ensuring that data in use is approved for use in flight?

Is the procedure for checking the EFB data approval consistent with standard operating procedures?

Can the crew request revision information from the EFB? Is the revision information presented clearly?

Are procedures in place so pilots know what to do if the database is not approved for use in flight?

Links to Related Material

Is access to related information supported?

Are similar types of information accessed in the same way?

Is it easy to return to the place where the user started from?

User-Interface Customization

tt) If the crew (i.e., end-user) can customize the appearance of the EFB (not related to panning/zooming), is it easy to reset all parameters to their default values? [Note: Crewmember customization capability is not a recommended practice. Customization may have an adverse affect on items in Section 1.1, General Considerations]

Is there a procedure or checklist item to ensure that crews clear all customized values?

Does the EFB auto-reset to default values upon shutdown so that the system starts up in a predictable state?

Does any customization have an adverse affect on items in Section 1.1, General Considerations?

uu) Is the operator capable of customizing the appearance of the EFB?

— If yes, is the customization controlled through an administrative process?

— Does any customization have an adverse affect on items in Section 1.1, General Considerations?

Hardware Considerations

Display

See also 0.1 in Section C (p. 18)

Is the display acceptable for use of the intended applications? Consider its resolution, brightness, off-axis readability, etc.

If artifacts appear on the display (e.g., ghost images or lines, jagged lines, or fuzzy images), do they impair the readability or functionality of the system?

Hardware Controls and Keyboards

vv) Are controls labeled consistently and briefly for their intended function?

ww) Can the user easily enter the most common types of input in any operational environment?

Can crews use pointing and cursor control devices (if any) quickly, accurately, reliably, and repeatedly under all environmental and lighting conditions (e.g., turbulence, darkness)?

xx) Is a keyboard appropriate for the task?

Do the keys provide sufficient tactile feedback in all environmental conditions (e.g., turbulence)?

Is key action firm enough to resist unintended actuation?

yy) Is inadvertent activation of controls deterred?

For example, do the physical keys provide tactile feedback?

If a key is held down for a long time, is the input processed correctly? (For example, multiple entries may need to be discarded.)

Accessibility of Hardware Components

See also 1.5.3 in Section B (p. 14)

zz) Are hardware components that are routinely used by the crew easy to access?

If not, is there any impact on flight task performance or safety?

aaa) Are the hardware components usable in the flight environment?

For example, will connectors stay in place after lengthy use in a vibrating environment or will a stylus remain functional?

If not, what mitigations are in place to ensure that the hardware components can be used?

ELECTRONIC DOCUMENTS

Training on Electronic Documents

Is there a training program on how to display and interact with electronic documents? Is it adequate?

Document Organization and Appearance

bbb) Can the crews find the material they are looking for?

Is the information organized in a way that makes sense to the crews?

Is the information arranged in a consistent way on the screen so that the crews know where to look for specific types of information?

Is it obvious when text is out of view? Is it easy to bring that text into view?

Can the crew tell where they are in relation to the full document?

Can the crew tell where they are in relation to the section of the document they are currently viewing?

ccc) Is the text of the document easy to read on the screen?

Is white space used to separate short main sections of text?

Is high priority information especially easy to read?

ddd) Are tables readable and usable?

How are especially long and complex tables handled?

eee) Are figures readable and usable?

Can the entire figure be viewed at one time?

Can the crew zoom in to read details on the figure?

Interacting with Documents

fff) Is it easy to move quickly to specific locations (e.g., to the beginning of a section, or to recently visited locations)?

Are active regions (e.g., hyperlinks) clearly indicated?

ggg) Is it easy to move between documents quickly?

Is it easy to tell what document is currently in view?

Is there a list of available documents to choose from?

hhh) Can crews search the document electronically?

Is the search technique adequate?

iii) If animation is supported, does the crew have adequate control over it?

Can the crew start and stop the animation as needed?

Is there a text description of the animation that describes its contents (so the crews know its contents without running the segment)?

jjj) Is printing supported? If so, is it adequate?

Can crews select a portion of a document to be printed?

Is the hard copy usable?

Can the crew terminate a print job immediately, if necessary?

ELECTRONIC CHECKLIST SYSTEMS (ECL)

An ECL is Type B software if the checklist is "interactive" (e.g., item status is tracked). Such systems need only AEG review for initial approval. The FSDO/PI may need to evaluate use of ECL during 6-month operational evaluation. For ECL that are essentially static images of paper checklists, the FSDO may need to review a subset of the questions below.

Training for Electronic Checklist Systems

Is there a training program on how to display and interact with electronic checklists? Is it adequate?

Does using the electronic checklist produce the same crew actions that using the paper equivalent would?

Are crews trained on how to use any new or unique features of the electronic checklists (i.e., functions that are not supported with paper checklists)?

Are crews trained to know which checklists are supported electronically and which are not?

Are crews trained to be aware of the limits of the ECL automation? In particular, are they trained on the limits of any ECL “sensing” functions?

If the ECL senses aircraft status and uses this information to customize the checklists (e.g., by automatically selecting a decision branch), are any special training or procedures needed?

Access to Checklists

kkk) Is it easy to find and access specific checklists?

Are normal checklists available in the appropriate order of use?

Can checklists be accessed individually for review or reference?

During non-normal conditions, are relevant checklists especially easy to access?

lll) Is it easy to know where any given checklist will be found (on the EFB or on paper)?

If the electronic checklist refers the crew to a paper document, is the location of that document provided within the electronic checklist?

Checklist Appearance

Is the layout and formatting of the ECL clear?

Is the layout and formatting of the challenges and responses consistent with the paper checklist equivalent?

Managing Checklists

Can crews easily manage the checklists?

- Does each checklist have a constantly visible title that is distinct from other checklists?
- Can the crew easily pick which checklist they want to work on from a set of open checklists?
- Can crews page ahead to view items in a long checklist without changing the item they are actively working on?
- Can the crew close an incomplete checklist after acknowledging that it is not complete?
- Is it clear when no checklists are open?
- During non-normal conditions, does the system indicate which checklists need to be performed or possibly ignored?
- Does the ECL discourage two checklists (or more) from being in progress simultaneously?

Interacting with Checklist Items

See 0.1.5 in Section B (p. 14).

Interacting with Checklists

See 0.1.6 in Section B (p. 15).

Links Between Checklist Items and Related Information

See 0.1.7 in Section B (p. 15).

FLIGHT PERFORMANCE CALCULATIONS

Flight performance calculations are Type B software. Only AEG review is required for initial approval, although the FSDO/PI may need to observe use of this software during 6-month operational evaluation period. See Section B, p. 15 for suggested evaluation questions.

ELECTRONIC CHARTS

Electronic charts are Type B software if the pilot can pan and zoom to configure the view of the chart. Only AEG review is required for initial approval. The FSDO/PI may need to observe use of Electronic Charts during the 6-month operational evaluation period.

Training, Policy, and Procedures for Use of Electronic Charts

See also 5.1.1 in Section B, p. 16.

Is training required on the electronic chart application?

- Is the training adequate?
- Are crews trained on any new or unique features of the electronic chart function (i.e., functions that are not supported with paper charts)?
- Are crews aware of any differences in map scale, orientation, and database quality between the electronic charts and other similar flight deck displays (e.g., moving map displays, weather displays, or traffic displays)?
- If own-aircraft position is displayed, are pilots aware of the limitations of the display of own aircraft position?
- Are crews trained on operator policies pertaining to use of the electronic charts application?

Access to Charts

See 0 in Section B (p. 16).

Chart Appearance

See 0 in Section B (p. 17).

Interacting with Charts

See 0 in Section B (p. 17).

B. Additional AEG/ASI Operational Evaluation Questions

This section contains additional questions that may be appropriate specifically for evaluation by the AEG/ASI. In general, questions that are specific to the AEG/ASI are related to initial installations and training for a given aircraft. Some of the AEG/ASI questions provide for a more thorough evaluation, appropriate for EFBs that will be used in a more complex manner. For example, this section contains detailed questions on applications such as Electronic Charts, Flight Performance Calculations, and Electronic Checklists. References to other sections of this appendix are provided when particular topics are also covered elsewhere.

GENERAL EFB SYSTEM

General Considerations

1.1.1 Workload

See also 0 in Section A (p. 2).

Is an in-flight evaluation necessary? (An in-flight evaluation may be necessary if you are not able to adequately evaluate each function intended for this specific operation while on the ground.)

If so, did the in-flight evaluation confirm that the overall workload is acceptable?

Physical Placement

1.2.4 Design and Placement of Structural Cradle

mmm) Does the structural cradle obstruct visual or physical access to flight controls and/or displays?

Which controls/displays are affected, and how important are they during the different phases of flight in which the EFB will be used?

nnn) Does the structural cradle obstruct the emergency egress path?

ooo) Are there adjustment and locking capabilities for optimal viewing or storage?

Are crews able to adjust and lock the EFB or their seat position for optimal viewing or for storage?

Does the position for optimal EFB viewing/storage also provide comfortable and reasonable access to all flight controls during both on ground and in-flight operations?

ppp) Is there adequate room to manipulate the device controls and view its display?

qqq) Is the installation design acceptable for use in high workload flight phases?

Consider ease of access if used during high workload flight phases.

Training/Procedures Considerations

1.3.3 EFB Training

See also 0 in Section C (p. 18).

What are the minimum training, checking and currency requirements?

Is EFB training customized for new users?

Software Considerations

1.4.1 User Interface—General Design

See also 0 in Section A (p. 6).

Is the user interface internally consistent?

Are there standard ways to perform common actions?

Are a common set of controls and graphical elements used?

Was a style guide followed when developing the user interface?

1.4.2 General Use of Colors

See also 0 in Section A (p. 6).

Are colors that convey meaning used in combination with other cues, such as shape?

For example, could the pilot understand all the information even if the screen was black and white?

1.4.7 Alerts and Reminders

rrr) For installed systems, do EFB alerts and reminders meet the requirements in the appropriate regulations (specifically §§ 23.1322 or 25.1322, as noted in FAA AC 120-76A, Par 10)?

sss) Is there an overall scheme for generating alerts/reminders (e.g., when will they appear, how are they prioritized)?

Is it adequate/appropriate?

ttt) Are distracting flashing symbols avoided?

uuu) Are EFB messages inhibited during high workload phases of flight unless they pertain to the failure or degradation of the current EFB application?

1.4.8 Display of System Status

vvv) Are partial or full failures of the EFB clearly indicated with a positive indication, not lack of an indication?

www) Is the immediacy of the failure annunciation appropriate to the function that is lost or disabled? (For example, failures of low-criticality functions should not produce intrusive alerts.)

Hardware Considerations

1.5.3 Accessibility of Hardware Components

See also 0 in Section A (p. 9).

Are the connectors easy to use?

Consider how long it takes to make the connections, how likely errors will be, and whether any special tools are required.

ELECTRONIC DOCUMENTS

No additional questions for an AEG/ASI review.

ELECTRONIC CHECKLIST SYSTEMS (ECL)

3.1.5 Interacting with Checklist Items

xxx) Is progress through the checklist clear to the flight crew?

Is the active item clearly indicated?

yyy) Is item status tracked by the system and displayed to the crew (e.g., completed, deferred, or open)?

Is item status displayed clearly under all lighting conditions?

zzz) Can the crew easily change the status of an item?

Can the crew easily mark an item complete?

After completing an item, does the next item in the list automatically become active?

Can the crew defer the current item without completing it?

Can the crew easily reset an item's status to "incomplete"?

Can crews easily reset all items within checklist to "incomplete" in order to begin the checklist again?

Is it possible to change an item that is not currently in view? If so, is the item that was changed brought to the crew's attention?

aaaa) Can the crew easily move between items within a checklist?

Can the crew easily move the active-item pointer to the next checklist item?

Can the crew move backward to a previous checklist item without affecting the status of any item? If the user moves forward in the checklist, are deferred items marked appropriately?

Does the active item change to the next one in the list after an item is completed? Is there a tendency to skip items when attempting to move to the next item?

Is a separate action required to move to the next page after all the items on the current page are completed or deferred?

3.1.6 Interacting with Checklists

bbbb) If the crew attempts to close an incomplete checklist, are they reminded to review deferred and incomplete items?

cccc) When finishing a checklist, is there a clear indication to the crew that all individual items in the checklist are complete, as well as an indication that the checklist as a whole is complete?

dddd) Does the checklist provide reminders for tasks that require a delayed action (e.g., dumping fuel)?

Do the reminders clearly specify what to do?

eeee) Does the checklist visually highlight decision branches?

If so, are the decision branches clear?

Can the crew easily back up if they choose the wrong branch?

3.1.7 Links Between Checklist Items and Related Information

If the ECL provide links to useful, related information (e.g., links to worksheets or definitions):

Is it easy to select what information to view?

Can the user return to the checklist from related information in one step?

Is the related information always shown in one window or area of the screen regardless of how many links were selected?

FLIGHT PERFORMANCE CALCULATIONS

Training for Flight Performance Calculations

Is there a training program on using the flight performance application? Is it adequate?

Do crews know when they can (or should) use the flight performance application?

Are crews aware of any assumptions on which the calculations are based? For example, are crews trained to identify and review default values and assumptions about the aircraft status or environmental conditions?

Do crews know how to enter information required by the software (e.g., corrections for temperature, pressure altitude, braking action, etc.)?

Do crews understand how to interpret and use results of the flight performance calculations? For example, will the results be entered into a flight management system?

Are the roles of dispatchers and flight crews coordinated?

Data Entry

a. Does the system identify entries that are clearly of the incorrect format or type and generate an appropriate error message?

   Does the error message clarify the type and range of data expected?

   Are errors in data entry identified at the earlier possible point?

b. Are units for performance data clearly labeled?

   Do the labels used in the EFB match the language of other operator documents?

c. Is all the information necessary for a given task presented together, or easily accessible?

d. Are any data (especially defaults values) obtained from other flight deck systems?

   If yes, what is the backup plan for assigning these values if communication with the other system is lost?

Modifying Performance Calculations

a. Can the crews modify performance calculations easily?

   Is it especially easy to make changes that might be done at the last minute?

b. Are outdated results of performance calculations deleted when modifications are entered?

Aircraft Performance Documentation

What is the procedure for ensuring that, if necessary, EFB data can be stored outside of the device? (see 14 CFR Part 121.697)

ELECTRONIC CHARTS

Training, Policy, and Procedures for Use of Electronic Charts

See also 0 in Section A (p. 11).

For Part 121/135 operators, does the EFB policy specifically address the electronic charts application?

   Does the policy specify what other EFB functions or applications (if any) can be used while a procedure using the electronic charts is actively being flown?

   Does the policy address special procedures that may apply if the electronic chart application senses and uses aircraft state (e.g., ownship position) to customize its functions?

Access to Charts

a) Can crews find and display the charts that they are looking for quickly and accurately?

   Is there a way to pre-select specific charts for especially easy access during a particular flight?

   Can crews easily identify errors in chart selection?

   Is there more than one way to search for a chart?

   If a last minute change is necessary, can the crew easily handle a clearance/runway change?

b) If the chart application uses aircraft state (e.g., ownship position) to facilitate access to charts, does this function work adequately?

   Are appropriate charts brought to the crew's attention?

   Can the crew disregard and override system suggestions easily?

c) Are there procedures to ensure that all necessary navigation/approach charts appropriate for the flight are installed and available?

Chart Appearance

a) Do the aeronautical charts conform to the guidelines of AC 211-2 “Recommended Standards for IFR Aeronautical Charts”?

b) Is chart scale information accurate and always visible?

Is the scale indicator updated when the display is zoomed?

Does the scale indicator stay in view as the display is panned?

Is the potentially inaccurate static scale information (which comes as part of the chart database) removed from the display?

c) If electronic chart symbols are color-coded, is the color code compatible with other EFB color conventions? (That is, are there any direct conflicts in color meaning between the EFB system and the chart application?)

d) If own-aircraft position is displayed, is it shown only on charts that are drawn to scale ("geo-referenced")?

Is the displayed position accurate to within the scale of the chart and does it remain accurate as the crew zooms?

e) If the chart application allows the crew to change between north-up and heading/track-up orientation, is the current orientation clear from the display behavior and/or a mode indicator?

If crews became confused about the display orientation, could significant errors result?

f) Are charts printed from an electronic chart application as usable as the original paper documents?

Interacting with Charts

a) Can crews use the electronic charts as well as they can use paper charts?

Can crews find and read specific detailed information (e.g., a radio frequency) on the electronic charts quickly (using zooming and panning as needed)?

Can crews use the electronic charts to orient themselves and track their progress as they fly the procedure (using zooming and panning as needed)?

Is there significant workload associated with configuring the electronic charts while flying the procedure (e.g., zooming/panning or other display customization)? Is display reconfiguration necessary often?

b) If de-cluttering is supported, can the crew easily switch between a de-cluttered and normal (not de-cluttered) display?

Is there a clear indication if and when any safety-related display elements are suppressed?

C. Additional FSDO/PI Operational Evaluation Questions

This section contains additional questions that are appropriate during an evaluation by the FSDO/PI. Questions that are specific to the FSDO/PI are generally related to documentation and long-term use of the EFB (e.g., during the 6-month operational evaluation). Questions in Section C are not appropriate for the AEG/ASI.

GENERAL EFB SYSTEM

General Considerations

No additional questions for FSDO/PI.

Physical Placement

No additional questions for FSDO/PI.

Training/Procedures Considerations

1.3.2 EFB Documentation and Policy

See also 0 in Section A (p. 5)

a) Does the air carrier have an explicit policy that addresses the use of the EFB in line operations?

   Is the policy easy to understand and follow?

   Is it distributed to applicable personnel?

   Does the policy adequately address each specific EFB application?

b) Did the operator incorporate EFB information from the manufacturer into its existing operating documents? (See also Appendix 1, “EFB Operational Approval Process”)

1.3.3 EFB Training

See also 1.3.3 in Section B (p. 13)

a) Does the carrier's initial EFB training include evaluation of knowledge and skill requirements?

   Does the training simulate key tasks?

b) Does the carrier's recurrent or continuing qualification training include evaluations of proficiency with the EFB during all appropriate evaluation gates?

1.3.5 User Feedback

a) Does the 6-month operational evaluation phase require that pilots and other users of the EFB provide post-flight evaluations?

   Is there a formal process for gathering feedback about the EFB and its support? Will feedback from this process be sent to the equipment manufacturer?

b) Does the operator provide input from personnel responsible for maintenance and data base management during the 6-month operational evaluation period?

Software Considerations

No additional questions for FSDO/PI.

Hardware Considerations

1.5.1 Display

See also 0 in Section A (p. 8)

Does the display continue to be usable after prolonged use in the flight deck environment?

For example, can the device be damaged under normal usage?

ELECTRONIC DOCUMENTS

No additional questions for FSDO/PI.

ELECTRONIC CHECKLIST SYSTEMS (ECL)

No additional questions for FSDO/PI.

FLIGHT PERFORMANCE CALCULATIONS

No additional questions for FSDO/PI.

ELECTRONIC CHARTS

No additional questions for FSDO/PI.

APPENDIX 8
AC 120-76A Frequently Asked Questions (FAQs)

The purpose of this section is to provide responses to frequently asked questions (FAQs) that are asked by industry concerning Advisory Circular (AC) 120-76A *"Guidelines for the Certification, Airworthiness, and Operational approval of Electronic Flight Bag Computing Devices."* These questions are frequently posed to Federal Aviation Administration (FAA) Aircraft Certification and Flight Standards authorities or others who provide interpretation of AC 120-76A. The responses in this section contain no new or additional guidance material.

(1) What is the primary purpose of EFB AC 120-76A?

Answer: The EFB AC provides guidance to convert millions of pieces of paper used for aircraft operations (e.g., maintenance logs, maintenance manuals, airplane flight manuals, en route charts, approach plates, weight & balance calculations) into electronic media to comply with certain operating rules. The EFB AC also provides guidance for a wide range of applications, including wireless communications with aircraft operations centers, which will aid in maintenance updates and improve dispatch times. Some EFB systems are evolving into aircraft administrative communication gateway systems, which should improve safety and efficiency relative to the existing manual paper entry process.

(2) Why do we allow operational approval of EFB Class 1 and 2 systems and Type A and B software applications without an Aircraft Certification design approval (e.g., TSOA, STC)?

Reference: EFB AC 120-76A pages 3-5, 7, 9 and Appendices A and B

Answer: Type A and B software applications that are hosted on EFB systems support operations that have traditionally been the responsibility of the Aircraft Evaluation Group (AEG) and Principal Inspectors (PI). Although the media supporting these operations has changed (from paper to electronic format), the aircraft operational requirements remain the same. The software used to create the paper products (e.g., approach charts, checklists, airplane flight manuals) does not require an Aircraft Certification design approval (e.g., TSOA, STC) because the existing paper products are operationally approved. Rather than replace the entire infrastructure with a new design process, the EFB AC allows incremental improvements to the existing system to improve efficiency and safety for certain airplane operations. The EFB system provides a safe and cost effective manner of replacing over forty pounds of manuals and millions of pieces of paper that is required to properly dispatch an air transport aircraft.

(3) What are the fundamental differences between EFB Class 1, 2 and 3 systems as described in the EFB AC?

Reference: EFB AC 120-76A pages 3-9 and Appendices A and B

Answer: EFB Class 1 and Class 2 systems are considered portable electronic devices and do not require a TSOA or aircraft certification design approval (e.g., STC). EFB Class 1 and 2 systems require operational approval (suitability for use) from the PI/AEG. The aircraft connectivity interfaces; (1) aircraft power port(s), (2) mounting bracket(s) and (3) data link(s) require an aircraft certification installation approval (see questions 7 and 8 below).
The rationale for the classifying EFB Class 1 and 2 systems as portable is that the software applications are limited to operational applications that have traditionally been supported by paper products. Because existing flight crew flight bags (filled with paper) have been considered "portable," the electronic versions are also considered "portable." These types of applications have been

traditionally approved by the Flight Standards Service and have not required Aircraft Certification oversight.
EFB Class 3 systems enable additional software applications that have traditionally had the oversight of the Aircraft Certification Service. The EFB Class 3 system is a powerful tool because it allows both operationally approved (Type A and B software applications) and Aircraft Certification design-approved software to reside on the same platform with partitioning.
EFB Class 3 systems may install user-loadable/user-modifiable software for the Type A and B software applications. Type A and B software applications do not require an Aircraft Certification design approval or compliance to RTCA DO-178B. The reason for this is to ensure consistency of the approval process for Type A and B software applications, regardless of the EFB system classification.

(4) Type A, B and C software applications are described in the EFB AC. What types of software applications are allowed to be installed in EFB Class 1, 2 and 3 systems?

Reference: EFB AC 120-76A pages 3-9 and Appendices A and B

Answer: Type A and B software applications may be installed on Class 1, 2 and 3 EFB systems. Regardless of the EFB system class (1, 2 or 3), the Type A and B software applications do not require an aircraft certification design approval or compliance with RTCA DO-178B.
Type C software applications require an Aircraft Certification design approval and compliance with RTCA DO-178B, and may only be installed on EFB Class 3 systems with one exception.
Specifically, Type C software applications may be installed on EFB Class 1 and 2 systems for TSOA functions that are limited to a "minor" failure effect classification. An example is TSO C-165, *"Electronic Map Display Equipment for Graphical Depiction of Aircraft Position"* which provides minimum standards for depiction of own ship position for surface operations with a "minor" failure effect classification. EFB Class 1 and 2 systems are not allowed to depict aircraft position for airborne applications because the failure classification of this application defined in the TSOA C-165 is "major."

(5) Is it acceptable for Type A and B software applications to be operationally approved on EFB Class 3 installed systems? Is compliance to RTCA DO-178B *"Software Considerations in Airborne Systems and Equipment Certification"* required?

Reference: EFB AC 120-76A page 7

Answer: User-loadable/user-modifiable software for Type A and B software applications may be installed on EFB Class 3 systems. These Type A and B software applications do not require an Aircraft Certification design approval or compliance with RTCA DO-178B. The reason for this is to ensure consistency of the approval process for Type A and B software applications regardless of the EFB system classification. Type C software applications must be protected from the Type A and B software applications. EFB Class 3 systems require that the hardware components receive an Aircraft Certification installation approval.

(6) What are the roles of the Principal Inspector (PI) and Aircraft Evaluation Group (AEG) to ensure that the Type A and B software applications meet their intended functions?

Reference: EFB AC 120-76A page 5-7, 19

Answer: It is the responsibility of the applicant and/or the software vendor to ensure that its operating system and Type A and B software applications meet their intended function. The PI/AEG is responsible for conducting an operational review of the overall system performance to ensure its acceptability prior to granting operational approval. The PI/AEG review of the overall system performance is based in part on the EFB system users manual/pilot's guide. The PI/AEG is not responsible for conducting any software design process reviews (e.g., RTCA DO-178B, COTS

software) because the applicant and/or the software vendor is responsible for ensuring that the EFB system meets its intended function.

(7) EFB connectivity to aircraft power and data busses is described on page 5 of the EFB AC. What are the minimum certification requirements for EFB aircraft power connectivity and how do we demonstrate intended function?

Reference: Policy Statement No. ANM-01-111-165 on Certification of Power Supply Systems for Portable Electronic Devices on Part 25 Airplanes, dated March 18, 2005 (Available at http://www.faa.gov)

Answer: The referenced policy statement on Certification of Power Supply Systems for Portable Electronic Devices on Part 25 Airplanes, dated March 18, 2005 is one method of compliance to the Federal Aviation Regulations for Transport Category Airplanes.

(8) What are the minimum certification requirements for EFB connectivity to aircraft data links (wired or wireless) and how do we demonstrate intended function?

Reference: EFB AC 120-76A pages 4-5

Answer: EFB Class 1 and 2 systems may use data connectivity in a "read-only" manner to receive information from aircraft avionics. An example is to receive information from an avionics system ARINC-429 port. EFB Class 1 and 2 systems may receive/transmit information for Aircraft Administrative Control process via data connectivity. An example is receive/transmit information from wireless connectivity from an EFB system to an aircraft operations center (e.g., gate link). EFB Class 1 and 2 systems may receive/transmit information to a certified avionics router with firewall protection to ensure that failures will have no safety effect on the aircraft avionics. The aircraft data connectivity interface must be certified, but the EFB system operation with the aircraft certified data connection may be operationally approved.

Applicants must demonstrate that safety mechanisms are in place to prevent EFB data connectivity failures from having adverse effects on aircraft avionics systems. Applicants must demonstrate that the data connectivity ports meet intended function. An EFB system certification demonstration may be required to ensure the intended function of the data connectivity. The certification demonstration should be limited to verifying that the data connectivity port(s) meets intended function.

In summary, the Aircraft Certification evaluation and design approval will be limited to airworthiness approval of the applicable mounting device (e.g., arm-mounted, kneeboard, cradle), crashworthiness, data connectivity, and EFB power connection(s).

(9) Is it possible to connect Class 1 and 2 EFB systems to wireless networks and/or ACARS interfaces?

Reference: EFB AC pages 1, 4-5

Answer: Yes, for Aircraft Administrative Communication (AAC) but not for Air Traffic Control (ATC) Communication. A definition for Aircraft Administration Communication is contained in the EFB advisory circular on page 1.

(10) Is the operator allowed to display own-ship position on EFB Class 1, 2 and 3 systems for surface and airborne operations?

Reference: EFB AC 120-76A, pages 4, 8 and Appendix B

Answer: Yes and No.

- Class 1 and 2 Systems

- Airborne operations—**NO**. Depiction of aircraft own-ship position for airborne operations is *not* allowed on EFB Class 1 and 2 systems because the failure effect classification for airborne applications is defined as "major" in Technical Standard Order C-165 (TSO-C-165), *Electronic Map Display Equipment for Graphical Depiction of Aircraft Position.*

- Surface operations—**YES**. Depiction of aircraft own-ship position when limited to surface operations *is* allowed on EFB Class 1 and 2 systems because the failure classification for surface applications is defined as "minor" in TSO C-165.

NOTE: TSO C-165 provides minimum standards, for example, failure effect classification, for depiction of own-ship position.
NOTE: Type "C" EFB software applications may be installed on EFB Class 1 and 2 systems for TSO authorization (TSOA) functions that are limited to a "minor" failure effect classification.

- Non-TSO C-165 EFB systems—The EFB AC, AC 120-76A, allows moving maps on EFB Class 1 and 2 systems for pre-composed or dynamic interactive electronic aeronautical charts (e.g., en route, terminal area, approach, and airport surface maps) including, but not limited to, centering and page turning, but **without display of aircraft own-ship position**. This is consistent with the European Joint Aviation Authorities (JAA) Administrative and Guidance Material contained in Temporary Guidance Leaflet (TGL) Number 36, *Approval of Electronic Flight Bags.*

- Class 3 Systems

  - **YES**. Class 3 systems may display own-ship position for both surface and airborne operations as an EFB Type "C" application. Type "C" applications require design approval from the Aircraft Certification Service and must comply with software assurance guidance in accordance with AC 20-115B, *RTCA, Inc. Document RTCA/DO-178B, Software considerations in Airborne Systems and Equipment Certification.*

(11) Is it possible to have moving maps without own ship position on portable EFB systems Class 1 and 2 systems without TSOA for both surface and airborne operations?

Reference: EFB AC 120-76A, page 4 and Appendix B

Answer: Yes, the EFB AC provides guidance for GPS page-centering of charts, page turning for en route charts and panning and zooming of various display information without own-ship position. The GPS position source may be installed (aircraft certification design approval) or portable (AEG/PI operational approval).

(12) Have other International Civil Aviation Authorities published guidance on the airworthiness and operational approval of EFB systems?

Reference: European JAA Administrative & Guidance Material contained in Temporary Guidance Leaflet (TGL) No. 36 *"Approval of Electronic Flight Bags"*

Answer: Although the guidance material has been harmonized between the EFB TGL 36 and EFB AC 120-76A there are some differences. Specifically:

(1) The EFB TGL 36 is more restrictive in the use of color red on the EFB Display (e.g., weather information).

(2) The EFB TGL 36 requires that Lithium batteries meet the United Laboratories (UL) standards.

(3) The EFB TGL states that the EFB Class 1 and 2 systems should comply with the requirements of ED-14/DO-160 Section 21 *"Emission of Radio Frequency Energy."*

(13) What are the minimum requirements for EFB systems compliance during aircraft rapid decompressions?

Reference: EFB AC 120-76A page 16

Answer: There are two basic failure modes of the EFB systems that need to be considered for aircraft rapid decompression: loss of function and rapid-decompression explosion of the EFB system, which could impair the flight crew. Demonstration of the EFB system fault tolerance during rapid decompression or paper/procedural backup may be required during non-normal flight operations. Some operators are using hardened EFB platforms with "sealed" drive to ensure continued operation after aircraft rapid de-compression. Loss of the EFB function during rapid decompression may be mitigated by paper backup or operational procedures.

(14) What is the definition of and Federal Aviation Regulation (FAR) reference for "installed equipment" as applied to EFB Class 3 systems?

Answer: The intent of AC 120-76A is that all of the rules for normal avionics certification would also apply to EFB Class 3 systems with the exception of user-loadable/user-modifiable Type A and B software applications. The Type A and B software applications require PI/AEG approval, but do not require an Aircraft Certification design approval.

(15) The Advisory Circular 120-76A provides guidance for Part 91F aircraft. What is a Part 91F operator required to do in relation to aircraft certification versus operational approvals?

Reference: EFB AC 120-76A page 1

Answer: There are requirements outlined in the AC relative to certifying the installation of aircraft mounting devices, ship's power sources or, in some cases, data connectivity. These EFB mounting brackets and connectivity ports require an Aircraft Certification design approval (e.g., STC). In addition, any EFB operator, including Part 91F, will need to respond to specific recommendations made in a Flight Standardization Board (FSB) report. For example, the operator may need to address supplemental training recommendations in the operator's manual/pilot guide.

(16) What EFB documentation should a Part 91F operator provide if "ramp checked" by the FAA Principal Inspector?

Reference: AC 91.21-1 and EFB AC 120-76A pages 19-22

Answer: The operator should ensure that any documentation resulting from an FAA approval method such as an FSB report or an STC is readily available. The AC includes the reference information pertaining to approved manuals, specific functionality and equipage requirements. It also emphasizes applicability of data storage and retrieval to meet FAA and NTSB requirements. Also, Part 91.21 requires that any operator ensure that an EFB or any other electronic device does not cause interference with aircraft systems; operators can reference the compliance to guidance contained in the current version of AC 91.21-1.

It is recommended that all operators comply with the guidance in the EFB AC including risk mitigation and operational testing. Beyond the minimum operational performance guidance material specified in the EFB AC, an operator may choose to have available the documentation from the

process and/or training they used to place the EFB in operation. Specific written procedures for the pilot(s) beyond those included in the operators/pilot guide may also be advisable depending upon the complexity of the installation and the EFB system operational functionality.

(17) The AC speaks to "administrative control" of an EFB. Does this apply to Part 91F operators?

Reference: EFB AC 120-76A page 3 and 5

Answer: Because the AC was primarily written primarily to address operators that have FAA approved programs, who require operation or management specifications (OpsSpec/Mspec), it is silent on many aspects of alternative methods of compliance. An administrative control process is usually associated with a certificated operator's approved program. However, there may be functionality imbedded in a current or future EFB application that requires a control process (e.g., Minimum Equipment List, MEL, and/or Configuration Deviation List, CDL, action) as described in the AC.

(18) The AC states that the operator is required to demonstrate that the EFB system must meet intended function, but it does not clearly state what the FAA "approves." What type of documentation must the operator provide to show that the EFB system meets intended function?

Reference: EFB AC 120-76A, multiple references

Answer: Per the EFB AC, the operator is responsible for demonstrating that the EFB system meets intended function. The following are the typical responsibilities of the operator: risk mitigation, electronic non-interference testing, operational sufficiency, intended function, no false or hazardously misleading information and crew procedures/training. Some of these items may be addressed during an Aircraft Certification process or FSB report and would be the responsibility of the appropriate FAA authority. The AC clearly requires that the operator perform a six-month operational evaluation and document the results considering the above general areas. For certificated operators and Part 91K, there will still be training program approvals, Ops/M Specs, etc. but the AC places the burden on the operator to provide the information.

APPENDIX 9

EFB User-Interface Assessment Tool

The EFB user-interface assessment tool was originally developed for use by Aircraft Certification specialists, but it may be used as a reference by anyone evaluating an EFB. Note that there is no requirement for either the FAA or industry to use this tool.

The tool provides a short list of EFB usability topics to consider during a brief office evaluation. This tool is applicable to all EFBs, with customized topics for four applications (electronic documents, electronic checklists, flight performance calculations, and electronic charts). The evaluator should go through the items for each topic, commenting about each one. For each item, the evaluator should provide supporting examples from the EFB and, if s/he chooses, preliminary assessments of problem severity. Because the capabilities and designs of EFBs vary from system to system, there is some overlap between the topics.

Note: This tool was designed for use by evaluators who may not be knowledgeable in human factors. More information on how to use this tool can be found in the report, *Designing a Tool to Assess the Usability of Electronic Flight Bags (EFBs)* (Report No. DOT/FAA/AR-04/38). More detailed human factors guidance on EFBs can be found in *Human factors considerations in the design and evaluation of Electronic Flight Bags (EFBs), Version 2* (DOT-VNTSC-FAA-03-07 and DOT/FAA/AR-03/67). Both documents are available at www.volpe.dot.gov/opsad/efb.

EFB User-Interface Assessment Tool

HARDWARE CONSIDERATIONS

- Physical Ease of Use
  — Input devices and display, accessibility of controls
- Labels and Controls
- Lighting Issues (day vs. night use)
  — Brightness adjustment, illumination of labels
- Amount of feedback, potential for errors

SOFTWARE CONSIDERATIONS

Symbols and Graphical Icons

- Clarity of intended meaning, confusability
- Legibility and distinctiveness

Formatting/Layout

- Fonts (size, style, case, spacing)
- Arrangement of information on the display
  — Consistency with user expectations and internal logic

Electronic Documents

- Indication of active regions and off-screen material
- Figures/tables
- Page format

- Structure and organization, consistency with hard copy

Electronic Checklists

- Display of item status, e.g., open, deferred, completed
- Indication of checklist status, e.g., open, closed, completed, active
- Formatting (e.g., associating challenges with responses)
- Consistency with hard copy

Electronic Charts

- Formatting
- Structure and organization, consistency with hard copy

Interaction (Accessing functions and options)

- Home pages and ease of movement between pages
- Number of inputs to complete a task
- Ease of accessing functions and options
- Feedback (system state, alerts, modes, etc)
- Responsiveness
- Intuitive logic

Electronic Documents

- Moving within a document, moving between documents
- Identifying open documents, identifying current document
- Zooming
- Search functionality

Electronic Checklists

- Accessing checklists and moving between checklists
- Managing checklists, e.g., parent-child relationships, master list
- Identifying open checklists, identifying current checklist
- Moving between items
- Linking between items, calculated values, other related information

Flight Performance Calculations

- Modifying performance calculations

Electronic Charts

- Access to charts
- Identifying open charts, identifying current charts
- Zooming and panning
- De-cluttering and display configuration (e.g., scale, orientation)
- Search functionality

Error handling and prevention

- Susceptibility to error (mode errors, selection errors, data entry errors, reading errors, etc.)
- Correcting errors (e.g., cancel, clear, undo)
- Error messages

Electronic Charts

- Updating chart information
- Scale information

Flight Performance Calculations

- Data entry

Multiple Applications

- Consistency and compatibility across applications
- Identifying current position within system
- Ease of switching between applications

Automation (if any)

- Is there enough? Too much?
- Is it disruptive/supportive? Predictable? User control over automation? (e.g., manual override)

General

- Consistency of controls/elements; are they distinctive where appropriate?
- Visual, audio, and tactile characteristics
- Use of color (esp. red and amber) and color-coding
- Amount of feedback (system state, alerts, modes, etc)
- Clarity and consistency of language, terms, and abbreviations
- End-user customization (if any)

Electronic Documents

- Printing (if available), printouts
- Animation (if any)

Electronic Checklists

- Set of checklists that are supported
- Presentation of task reminders (if any)

Flight Performance Calculations

- Unit labels
- Default values

Electronic Charts

- If own-aircraft/ownship display, see TSO C-165
- Printing (if available), printouts

WORKLOAD

- Problem areas

OTHER