U.S. Department
of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Installation of Electronic Flight Bag Components

Date: 09/27/11 **AC No:** 20-173
Initiated by: AIR-130

1. Purpose.

a. This advisory circular (AC) provides guidance material on the installation of electronic flight bag (EFB) components including aircraft connectivity provisions. In it, the Federal Aviation Administration (FAA) describes certification considerations for individual EFB components and for installing EFB aircraft connectivity provisions by addressing the principal elements, or "components," which comprise a typical EFB device or system.

b. This AC describes an acceptable means, but not the only means, to comply with Title 14 of the Code of Federal Regulations (14 CFR) part 23, 25, 27, or 29. This AC is not mandatory and does not constitute a regulation. However, if you use the means described in this AC, you must follow it entirely. The term "must" is used to indicate mandatory requirements when following the guidance in this AC. The terms "should" and "recommend" are used when following the guidance is recommended but not required to comply with this AC.

2. Audience. This AC should be used by EFB system designers, installers, and operators installing EFB components, including aircraft connectivity provisions.

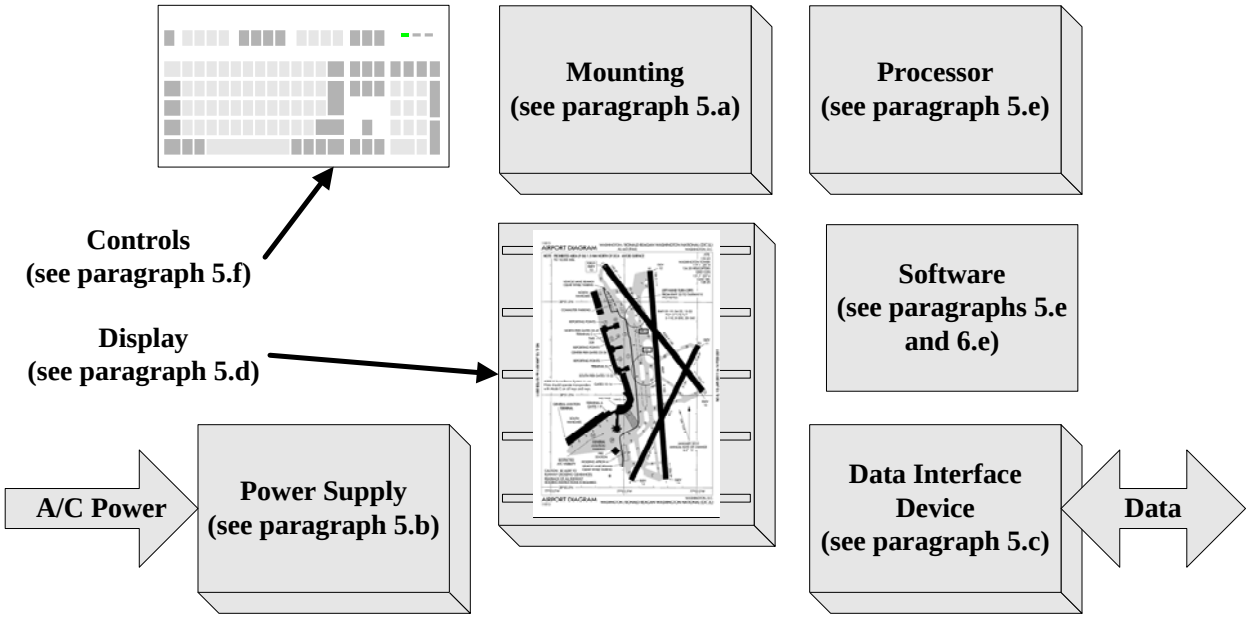
3. Scope. This AC addresses installation of EFB components. In the context of this AC, EFB components are "installed" when they are incorporated into aircraft type design under 14 CFR part 21 or as a proper alteration under 14 CFR 43.3. All other EFB components are considered "portable," regardless of how often they are removed from the aircraft. There are operational restrictions on the use and capability of portable EFB components. Design of portable EFB components is outside the scope of this AC.

4. Background.

a. What is an EFB? EFBs provide replacement for the paper reference material pilots typically carry. In order to qualify as an EFB, the system must be capable of displaying information equivalent to the paper products they replace. A list of EFB applications is provided in AC 120-76, *Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices,* appendices A and B.

b. EFB Components. An EFB consists of several EFB components, which may be portable or installed. Refer to AC 120-76 or AC 91-78, *Use of Class 1 or Class 2 Electronic Flight Bag (EFB)*, for EFB components which remain portable. The applicant is responsible for identifying what components or provisions are installed as part of their application. Figure 1 displays the typical EFB system components addressed by this AC.

Figure 1. Typical EFB System Components



c. Airworthiness Applicability. Airworthiness regulations apply to installed EFB components. They do not apply to portable EFB components other than for specifications associated with the installed components (i.e., mounting (size and weight), power (maximum electrical load), and data connectivity (input/output specifications and security)).

d. EFB Operational Guidance Under 14 CFR Part 91 Subparts F and K, 121, 125, 129, or 135. Guidance on the operational authorization to use an EFB onboard aircraft operating under 14 CFR part 91 subpart K, 121, 125, 129, or 135 is provided in AC 120-76. AC 120-76 defines EFB equipment "classes" and "types" of applications. "Portable EFBs" are defined as Class 1 and Class 2, and "installed EFBs" as Class 3 EFBs. EFB applications for paper replacement are defined as Type A and B applications. Non-EFB applications are referred to as Type C applications. Use of the guidance in AC 120-76 is recommended for aircraft operating under 14 CFR part 91 subpart F.

e. EFB Operational Guidance Under 14 CFR Part 91. Guidance on the operational use of EFBs for pilots operating under 14 CFR part 91 is provided in AC 91-78. AC 91-78 describes means to remove paper references from the cockpit for operations under 14 CFR part 91 (other than subpart K).

5. Guidance for Installed EFB Components.

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

(1) **Accessibility.** The mount and associated mechanism should not impede the flightcrew in the performance of any task (normal, abnormal, or emergency) associated with operating any aircraft system and must not compromise the intended function of other installed equipment. If the EFB display is installed, the display must be easily viewed and the controls easily reached without requiring major adjustments to body position.

> **Note:** Evaluation of a portable EFB display is accomplished by the operator in accordance with AC 91-78 or AC 120-76.

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

(3) **Crashworthiness.** The design must address applicable crashworthiness regulations. This includes the appropriate restraint of any device, when in use or in designated stowage mounts. Design must address the 14 CFR 23.561, 25.561, 27.561, or 29.561 requirements for part 23, 25, 27, or 29, as applicable. For part 25 aircraft, mounting design must address the 14 CFR 25.789 requirements for installed EFB components.

(4) **Yoke Mounts and Clips**. Applicants and operators should be aware of unsafe conditions potentially created when attaching a portable EFB component to the control yoke with an attachment mechanism, mounting device, or clip. For example, the weight of both the EFB and mounting bracket may affect flight control system dynamics or warning indications, such as aerodynamic disturbances or from artificial stall-warning devices (e.g., stick shaker); even though the mount alone may be light enough to be insignificant. The mass, moment of inertia, as well as the physical size of the combined mount and EFB, can all contribute to potential unsafe conditions which may require design changes to flight controls and additional flight testing upon installation. In 14 CFR parts 25, 27, and 29 aircraft, yoke mounting of an EFB is not recommended and all of the yoke mounting components (e.g., mounts, brackets, clips, etc.) for the EFB must be incorporated into the aircraft type design. When the EFB mounting device is not intended for a specific EFB model, document the demonstrated performance parameters for the mounting device (e.g., weight parameters) in the airplane or rotorcraft flight manual (AFM/RFM), airplane or rotorcraft flight manual supplement (AFMS/RFMS), operating manual, or instructions for continued airworthiness (ICAs), as appropriate.

(5) **Use of Hook-and-Loop Fasteners**. We do not recommend use of hook-and-loop fasteners, such as Velcro®, for mounting or securing EFB components to a mount, or the

aircraft, because the closure strength of hook-and-loop fasteners degrades with each use. The cycle life, which is the number of times the hooks and loops can be engaged and disengaged before the closure strength is reduced to 50% of original values, cannot be accurately tracked without a maintenance action. However, if using hook-and-loop fasteners for installed EFB mounts to ensure crashworthiness:

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

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

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

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

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

(2) **Fault Protection.** An appropriate means of fault protection (e.g., circuit breaker) for the power port circuit should be provided. Ensure the circuit protective device requirements under 14 CFR 23.1357, 25.1357, 27.1357, or 29.1357 are met for parts 23, 25, 27, or 29, as applicable, to guard against inadvertent contact with energized parts of the system. If a fault is detected, the power port should be automatically deactivated. Automatic reset features should not be permitted.

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

(4) **Port Labeling.** Labeling of aircraft power ports should be provided to identify the electrical characteristics (e.g., 28 VDC, 115 VAC, 60 or 400 Hz, etc.) in order to address equipment sensitivity to voltage, current, or frequency parameters and to provide awareness to the flightcrew or maintenance personnel, reducing the likelihood of connecting incompatible devices to the power source. Given the variety of outlet and connector types used for various power sources and the variety of plug adapters available, outlet type alone is not considered to be

sufficient. The labeling placard must be legible, easy to see, and as close as practicable to the power port. The labeling placard should not impose any limitations on the portable EFB component itself, which is the operator's responsibility.

(5) **Mount Cabling.** If cabling is installed to mate aircraft systems with an EFB, the cable should not hang loosely and provisions should be made to easily secure any exposed cables out of the way during aircraft operations (e.g., cable tether straps). Cables external to the mount should be of sufficient length to perform the intended tasks. Cables too long or short must not present an operational or safety hazard. For part 25 airplanes, installed cables are considered electrical wiring interconnection systems and therefore need to comply with 14 CFR part 25 subpart H, and 14 CFR 26.11.

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

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

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

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

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

d. Display. This section provides design guidance for the installation of EFB displays, including installation of shared displays, supporting both portable EFBs and installed systems. Guidance on portable displays is not covered in this AC, but is addressed in AC 120-76 or AC 91-78, as applicable.

(1) **Placement.** Placement for EFB displays must meet the 14 CFR 23.773, 25.773, 27.773, or 29.773 requirements for parts 23, 25, 27, or 29, as applicable. Placement also needs to consider many other factors: accessibility, workload effects, and potential pilot fatigue effects from use, etc. Pilot compartment view considerations include glare, reflection, and visual field. For applicants seeking compliance under 14 CFR 25.773 for installed displays, flight testing in day and night conditions is the acceptable method to find compliance for these issues. Applicants may develop equivalent level of safety (ELOS) justifications for alternative means of compliance, provided they are formally requested and agreed to by the FAA in advance. Analysis, simulation, and demonstration of previously completed ground, flight testing, or service history on a similar platform may be considered when developing an alternative means of compliance. Portable displays should also be evaluated for external vision considerations with the intended EFB.

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

(3) **Recommended Display Standards.** Installed EFB displays are multipurpose display devices and we recommend use of the design standards found in Society of Automotive Engineers (SAE) Aerospace Standard (AS) 8034B, *Minimum Performance Standard for Airborne Multipurpose Electronic Displays*. For part 25 airplanes, display characteristics listed in AC 25-11, *Electronic Flight Deck Displays*, are applicable. For part 23 airplanes, apply the display characteristics listed in AC 23.1311-1, *Installation of Electronic Display in Part 23 Airplanes*. For other aircraft without corresponding criteria, the guidance in AC 25-11 or AC 23.1311-1 serves as recommended design guidance.

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

applications have no adverse effect on the safe and continued operation of approved software and other aircraft systems. EFB configurations include:

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

> **Note**: AC 20-159, *Obtaining Design and Production Approval for Airport Moving Map Display and Airport Surface Situational Awareness Applications Hosted In Electronic Flight Bags (EFBs),* provides a means to obtain a software-only technical standard order (TSO) authorization for airport moving map display (AMMD) and surface cockpit display of traffic information (CDTI) applications designed to reside with the hosted Type A/B applications.

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

(3) **Type A/B Applications Installed as Approved Software.** Historically, operators have used Type A/B applications on portable EFBs. However, it is acceptable to develop approved software to perform as Type A and B applications. For example, provided the intended function has been evaluated specifically for replacement of paper products, software with an airworthiness approval performing an aeronautical charting application should require no further evaluation by the AEG to be authorized for use in an EFB.

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

g. Rechargeable Lithium Batteries. Rechargeable lithium batteries (typically lithium-ion and lithium-polymer (lithium-ion polymer)) have higher energy levels than previous rechargeable batteries and also have higher flammability potential, so it is important to take precautions in their use. If mistreated, or not manufactured and maintained to industry safety standards, rechargeable lithium batteries can become hazardous. Installed EFBs employing rechargeable lithium batteries must ensure the lithium ion batteries meet airworthiness standards appropriate for the battery size and intended function. The use of rechargeable lithium batteries in portable devices is the responsibility of the operator (see AC 120-76 for applicable guidance).

6. Guidance Applicable to All Installed Components.

a. Airborne Electronic Hardware (AEH). For installed EFB components including complex custom AEH, if the failure condition classification is major or greater, develop the complex custom AEH using AC 20-152, *RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware*, to the design assurance level consistent with the failure condition classification. If the failure condition classification is minor, or no effect, an existing design assurance practice may be used to develop the complex custom AEH.

b. Environmental Qualification. Ensure the environmental qualification of installed EFB components is appropriate for the installation. We recommend utilizing AC 21-16, *RTCA/DO-160 Versions D, E, F, and G, "Environmental Conditions and Test Procedures for Airborne Equipment,"* to demonstrate equipment performance in environmental conditions encountered during operation of the EFB components in aircraft.

c. Lightning Protection. Ensure installed EFB components meet the lightning requirements of 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316, as appropriate. We recommend utilizing AC 20-136, *Aircraft Electrical And Electronic System Lightning Protection*, to demonstrate appropriate lightning protection.

d. High Intensity Radiated Fields (HIRF). Ensure installed EFB components meet the HIRF requirements of 14 CFR 23.1308, 25.1317, 27.1317, and 29.1317, as appropriate. We recommend utilizing AC 20-158, *The Certification of Aircraft Electrical and Electronic Systems For Operation In The High-Intensity Radiated Fields (HIRF) Environment*, to demonstrate the equipment is protected when operating on an aircraft when the aircraft is exposed to an external HIRF environment.

e. Software. Ensure the design assurance level of installed software is consistent with the failure condition classification for the intended function. Develop approved software using AC 20-115, *RTCA, Inc., Document RTCA/DO-178B*, or AC 20-171, *Alternatives to RTCA/DO-178B for Software in Airborne Systems and Equipment*.

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

(1) Typically, the failure condition classification of Type A/B applications, as defined in AC 120-76, is considered to be minor or no effect. AC 120-76 provides allowances for use of these applications on EFBs based on an equivalent level of safety to the paper reference material or operational process. When the Type A/B application is installed as part of aircraft type design or as an alteration, you may consider malfunction of the Type A/B application to be a minor failure condition classification and loss of the Type A/B application to have no safety effect, or you may accomplish a system safety assessment to determine the appropriate failure condition classification.

(2) If the EFB supports other applications, the failure classification will be driven by those other applications. If the EFB hosts Type A/B applications, adequate partitioning or

protection must be provided to ensure the EFB Type A/B applications have no adverse effects on those other applications. We recommend the use of ARP 4754A, *Guidelines for Development of Civil Aircraft and Systems*, and ARP 4761, *Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment,* when developing a partitioned installed EFB system and showing compliance with airworthiness regulations. For primary safety assessment guidance, please refer to the system design documents for each aircraft type:

(a) AC 23.1309-1, *System Safety Analysis and Assessment for Part 23 Airplanes.*

(b) AC 25.1309-1, *System Design and Analysis*.

(c) AC 27-1, *Certification of Normal Category Rotorcraft*.

(d) AC 29-2, *Certification of Transport Category Rotorcraft*.

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

g. Documentation. Expected performance information for installed EFB components listed in paragraph 5 of this AC should be documented following current flight manual guidance, and be included in the ICAs. For example, the components requiring this information include mounting devices (e.g., weight, size, adjustment parameters, and mounting procedures, etc.), power provisions (e.g., port labeling to identify the electrical characteristics (e.g., 28 VDC, 115 VAC, 60 or 400 Hz, etc.) of the power port, and operation of installed power switch, etc.), and data connectivity (e.g., available data provided via wired/wireless means, etc.).

7. Related References. All references to FAA documents in this AC are to the current version.

a. FAA ACs. You can get copies from our website at www.faa.gov/regulations_policies/advisory_circulars/.

(1) AC 21-16, *RTCA Document DO-160 versions D, E, F and G, "Environmental Conditions and Test Procedures for Airborne Equipment."*

(2) AC 20-115, *RTCA, Inc., Document RTCA/DO-178B.*

(3) AC 20-152, *RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware.*

(4) AC 20-159, *Obtaining Design and Production Approval for Airport Moving Map Display and Airport Surface Situational Awareness Applications Hosted In Electronic Flight Bags (EFBs).*

(5) AC 20-171, *Alternatives to RTCA/DO-178B for Software in Airborne Systems and Equipment.*

(6) AC 23.1309-1, *System Safety Analysis and Assessment for Part 23 Airplanes.*

(7) AC 23.1311-1, *Installation of Electronic Display in Part 23 Airplanes*.

(8) AC 25.1309-1, *System Design and Analysis*.

(9) AC 25-11, *Electronic Flight Deck Displays*.

(10) AC 25.773-1, *Pilot Compartment View Design Considerations.*

(11) AC 27-1, *Certification of Normal Category Rotorcraft.*

(12) AC 29-2, *Certification of Transport Category Rotorcraft.*

(13) AC 91.21-1, *Use of Portable Electronic Devices Aboard Aircraft.*

(14) AC 91-78, *Use of Class 1 or Class 2 Electronic Flight Bag (EFB).*

(15) AC 120-76, *Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices.*

b. FAA TSOs. You can find a current list of TSOs on the FAA Internet website at www.airweb.faa.gov/rgl. You will also find the TSO Index of Articles at the same site.

(1) TSO-C165, *Electronic Map Display Equipment for Graphical Depiction of Aircraft Position*.

(2) TSO-C195, *Avionics Supporting Automatic Dependent Surveillance – Broadcast (ADS-B) Aircraft Surveillance Applications (ASA).*

c. RTCA, Inc. Documents. You can order copies of RTCA documents from RTCA, Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone: (202) 833-9339. Also, order copies online at http://www.rtca.org.

(1) RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment,* dated December 18, 2010.

(2) RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification,* dated December 1, 1992.

(3) RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware,* dated April 19, 2000.

(4) RTCA/DO-257A, *Minimum Operation Performance Standards for the Depiction of Navigational Information on Electronic Maps,* dated June 25, 2003.

(5) RTCA/DO-317, *Minimum Operational Performance Standards (MOPS) for Aircraft Surveillance Applications System (ASAS),* dated April 14, 2009.

d. Society of Automotive Engineers (SAE) International Documents. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. Also, order copies online at http://www.sae.org.

(1) ARP 4754A, *Guidelines for Development of Civil Aircraft and Systems.*

(2) ARP 4761, *Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.*

(3) AS 8034B, *Minimum Performance Standard for Airborne Multipurpose Electronic Displays.*

Susan J. M. Cabler
Assistant Manager, Aircraft Engineering
Division