



U.S. Department
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Administration

Advisory Circular

Subject: Integrated Modular Avionics
Development, Verification, Integration, and
Approval Using RTCA/DO-297 and Technical
Standard Order-C153

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Purpose. This advisory circular (AC) sets forth an acceptable means of compliance for aircraft and engines that utilize Integrated Modular Avionics (IMA) systems. This AC calls out and supplements the guidance material of RTCA/DO-297, *Integrated Modular Avionics (IMA) Development Guidance and Certification Considerations*, dated November 8, 2005. This AC incorporates pertinent guidance material and information from AC 20-145, *Guidance for Integrated Modular Avionics (IMA) that Implement TSO-C153 Authorized Hardware Elements*. AC 20-145 is now cancelled.

Principal Changes. This change incorporates minor changes and updates, and a new appendix to AC 20-170. These changes are necessary in order to address incorrect references in RTCA/DO-297 when using SAE ARP 4754, Rev. A, which is recognized by AC 20-174. Information regarding whom you may contact with questions regarding the information in this AC, and where you may obtain a copy, are also included.

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sections of those industry standards as part of the IMA development, integration, verification, or approval process, you should consider those sections of the referenced industry standard (or other acceptable alternative means) to be part of the overall acceptable means of compliance as outlined in RTCA/DO-297.

Note: SAE International updated their ARP 4754 to ARP 4754A, "*Guidelines for Development of Civil Aircraft and Systems*" in December 2010. AC 20-174, *Development of Civil Aircraft and Systems*, dated September 30, 2011, recognizes ARP 4754A as an acceptable means of compliance for development of aircraft systems. This revision A reflects a significant change to that document, including section and paragraph numbering from that used in the original release. As a result, several references to ARP 4754 by RTCA/DO-297 are incorrect when using SAE ARP 4754A. Please see appendix H of this AC in order to cross reference ARP 4754 with ARP 4754A sections and paragraphs referenced by the original release of RTCA/DO-297.

b. You may use this AC as an acceptable means of compliance for a IMA systems that include TSO authorized articles. Although RTCA/DO-297 does not address TSOs, you should apply the intent of its objectives in Annex A to IMA systems that include TSO authorization(s) in order to obtain IMA system approval. See chapter 8 of this AC for more information.

c. If you choose to follow this AC to show compliance, apply the AC to your IMA development and approval process regardless of the complexity of the IMA system or business model under which it is developed and approved. RTCA/DO-297 is written primarily from the perspective of a complex IMA system developed and integrated by multiple organizations and companies (see RTCA/DO-297, subsection 2.4). Although the development, integration, verification, and approval of an IMA system developed by a single company are likely to be less complex than for multiple companies, RTCA/DO-297 applies equally. This AC should be used as an acceptable means of compliance for IMA systems that:

(1) Are developed by a single company as well as those developed by multiple companies. If a single company develops a complete IMA system, many of the separate roles defined in RTCA/DO-297 – such as IMA developer, application developer, and IMA integrator -- will be taken by this single company.

(2) Are *simple* IMA systems as well as *complex* IMA systems. These terms are purposely left undefined, because it is difficult to make a clear distinction between them. The purpose of this item is to illustrate that this AC should be applied to IMA systems of all levels of complexity.

(3) Are closed architecture as well as open architecture. (See Appendix E, Glossary.)

(4) Use TSO authorized components (that is, TSO-C153) and functional TSOs (such as TSO-C113, *Electronic Flight Displays* and TSO-C9, *Automatic Pilots*) as well as IMA systems that do not use TSO authorized components.

Note: Because of the variations described in c. above, not all aspects of RTCA/DO-297 or the additional guidance contained in this AC may apply to every IMA development program. We strongly recommend that any question regarding the application of this AC be discussed with us at the beginning of the certification program and the agreements reached during those discussions be documented. The FAA may require an Issue Paper on these questions.

d. Appendix A of this AC, Environmental Qualification Guidance for TSO-C153, *Integrated Modular Avionics Hardware Elements*, shows applicants for TSO-C153 authorization how to conduct environmental qualification testing (EQT) that ensures compliance to the minimum performance standard (MPS) of TSO-C153. We do not require compliance to appendix A if you are not using TSO-C153 authorized hardware components.

1-6. What This AC Covers. This AC describes an acceptable means by which to apply RTCA/DO-297, along with the additional guidance material included in this AC, to an aircraft or engine certification program which uses an IMA system. We cover the following subjects in detail:

- Acceptance and Incremental Acceptance (in chapter 2).
- Getting An IMA Component Acceptance Letter (in chapter 3).
- Reuse Of IMA Components (in chapter 4).
- Configuration Management of an IMA System (in chapter 5).
- IMA Recovery Features (in chapter 6).
- Additional Topics Not Covered by RTCA/DO-297 (in chapter 7).
- Use of TSO Authorized Components in IMA Systems (in chapter 8).

(2) Verification procedures to ensure that the software was correctly loaded into an approved, compatible target computer and memory device(s).

(3) Any post-load verification and/or test procedures required to show compliance to the guidelines specified in this AC.

(4) Actions to take – for example, prohibiting dispatch of aircraft – if there’s an unsuccessful load.

(5) Reference to an approved loading procedure.

(6) Maintenance record entry procedures required to document and maintain configuration control.

(7) Reference to the appropriate Aircraft Flight Manual (AFM), Aircraft Flight Manual Supplement (AFMS) or operator’s manual, if necessary.

7-3. Electronic Identification Guidance.

a. Identification of software components field-loaded into hardware elements should be implemented by electronic means. Electronic identification markings consist of identifying software components by electronically embedding the identification within software contained in the hardware, rather than on the equipment nameplate.

b. Electronic software part numbers and versions should be verifiable through an electronic query, such as an electronic display. Software part number configuration errors detected by an automated robust IMA configuration management function should be annunciated to the flight crew until appropriate maintenance action is performed.

c. Equipment authorized by TSO must be permanently and legibly marked with specific information. See § 45.15(b). The applicant can demonstrate compliance to § 45.15(b) when you provide the information required by an electronic identification query system stored in non-volatile memory. This approach is commonly called an “electronic TSO nameplate.” The electronic identification system should be verifiable onboard the aircraft when the aircraft is on the ground at any geographic location. It must provide the specific information for all applicable TSOs being marked is using the electronic TSO nameplate as the only means of labeling. See § 45.15(b).

d. Electronic identification may also provide software and hardware component revision or modification status information and RTCA/DO-178B software level. The applicant can use this to demonstrate conformity to type design configuration.

e. Include information identifying the location of each hardware component in the electronic identification. This is necessary because the configuration depends on the specific location of each hardware component within the cabinet or rack. You can satisfy this

Appendix D Related Documents And How To Get Them.

1. Copies of 14 CFR parts are available from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at www.access.gpo.gov. Select "Online Bookstore." Then select "Code of Federal Regulations."

2. The following ACs are available from the FAA website at http://www.faa.gov/regulations_policies/advisory_circulars/.

- 1) AC 20-88, *Guidelines on the Marking of Aircraft Powerplant Instruments (Displays)*.
- 2) AC 20-115, *RTCA, Inc. Document RTCA/DO-178B*.
- 3) AC 20-136A, *Protection of Aircraft Electrical/Electronic Systems Against the Indirect Effects of Lightning*.
- 4) AC 20-148, *Reusable Software Components*.
- 5) AC 20-152, *RTCA, Inc. Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware*.
- 6) AC 20-156, *Aviation Databus Assurance*.
- 7) AC 20-158, *The Certification of Aircraft Electrical and Electronic Systems for Operation in the High-Intensity Radiated Fields (HIRF) Environment*.
- 8) AC 20-174, *Development of Civil Aircraft and Systems*.
- 9) AC 21-16, *RTCA, Inc. Document RTCA/DO-160F*.
- 10) AC 23.1309-1, *System Safety Analysis and Assessment for Part 23 Airplanes*.
- 11) AC 23.1311-1B, *Installation of Electronic Displays in Part 23 Airplanes*.
- 12) AC 25-11A, *Electronic Flight Deck Displays*.
- 13) AC 25.1309-1, *System Design and Analysis*.
- 15) AC 25.1701-1, *Certification of Electrical Wiring Interconnection Systems on Transport Category Airplanes*.
- 15) AC 27-1, *Certification of Normal Category Rotorcraft*.
- 16) AC 29-2, *Certification of Transport Category Rotorcraft*.

17) AC 33.28-1, *Compliance Criteria For 14 CFR § 33.28, Aircraft Engines, Electrical And Electronic Engine Control Systems.*

18) AC 33.28-2, *Guidance Material For 14 CFR § 33.28, Reciprocating Engines, Electrical and Electronic Engine Control Systems.*

19) AC 33.75-1, *Guidance Material for 14 CFR 33.75, Safety Analysis.*

20) AC 120-64, *Operational Use and Modification of Electronic Checklists.*

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

3. The following FAA policy statements are available from the FAA website at http://www.faa.gov/regulations_policies.

1) FAA Policy Memo ANM-01-03, *Factors to Consider When Reviewing an Applicant's Proposed Human Factors Methods of Compliance for Flight Deck Certification.*

2) FAA Policy Memo ANM-99-2, *Guidance for Reviewing Certification Plans to Address Human Factors for Certification of Transport Airplane Flight Decks.*

3) FAA Policy Memo PS-ACE100-2001-004, *Guidance for Reviewing Certification Plans to Address Human Factors for Certification of Part 23 Airplanes.*

4. Order RTCA documents from RTCA, Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. You can also order copies online at www.rtca.org. We referenced the following RTCA documents:

1) RTCA/DO-160F, *Environmental Conditions and Test Procedures for Airborne Equipment.*

2) RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification.*

3) RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware.*

4) RTCA/DO-257A, *Minimum Performance Standards for the Depiction of Navigational Information on Electronic Maps.*

5) RTCA/DO-297, *Integrated Modular Avionics (IMA) Development Guidance and Certification Considerations.*

5. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. You can also order copies on-line at www.sae.org. We referenced the following SAE documents:

- 1) ARP4754 Rev A. *Guidelines for Development of Civil Aircraft and Systems*.
- 2) ARP4761, *Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment*.

Appendix H. SAE ARP 4754 to ARP 4754A Cross-Reference Matrix

Below is a cross-reference matrix between the sections and paragraphs of SAE ARP 4754 that are referenced by RTCA/DO-297 and the updated SAE ARP 4754A. Please refer to this matrix in order to determine the correct ARP 4754A paragraph.

RTCA/DO-297 Page # / Para. #	ARP 4754 Reference (Technical Subject of Discussion)	Corresponding ARP 4754A Reference / Para. # of Technical Subject of Discussion
3 / 1.5 [7]	ARP 4754	ARP 4754A
20 / 3.1	ARP 4754	ARP 4754A
56 / 4.5.7.d	ARP 4754	ARP 4754A
63 / 5.1	ARP 4754 (Safety Assessment)	ARP 4754A / 5.1
65 / 5.1.5.1	Section 6.1 (Functional Hazard Assessment)	ARP 4754A / 5.1.1
65 / 5.1.5.2.e	Section 6.2 (Preliminary System Safety Assessment)	ARP 4754A / 5.1.2
66 / 5.1.5.3.1	Section 6.3 (System Safety Assessment)	ARP 4754A / 5.1.3
66 / 5.1.5.4	ARP 4754 (Common Cause Analysis)	ARP 4754A / 5.1.4
72 / 5.3	ARP 4754 (Validation Process)	ARP 4754A / 5.4
73 / 5.4	ARP 4754 (Verification Process)	ARP 4754A / 5.5
75 / 5.5	ARP 4754 (Configuration Management Process)	ARP 4754A / 5.6
77 / 5.6	ARP 4754 (Quality Assurance Process)	ARP 4754A / 5.7
77 / 5.6 - Note	ARP 4754	ARP 4754A

Note: Some references within RTCA/DO-297 refer to the entire SAE ARP 4754 document, but the discussion in that RTCA/DO-297 paragraph is limited to a specific technical subject. This table provides information on the technical subject being discussed for that RTCA/DO-297 reference and provides the exact paragraph number of ARP 4754A. We believe that this information is of greater use to the reader than repeating the reference to the entire SAE ARP 4754A document. See rows 4, 8, 9, 10, 11, and 12.