Advisory Circular

U.S. Department of Transportation
Federal Aviation Administration

Subject: Selection of Cyclic Redundancy Code and Checksum Algorithms to Ensure Critical Data Integrity	**Date:** 8/4/2015 **Initiated By:** AIR-130	**AC No:** 00-66

1.   Purpose. This advisory circular (AC) provides information about the availability of resource material on digital data integrity. This information is in the form of a research report entitled "Selection of Cyclic Redundancy Code and Checksum Algorithms to Ensure Critical Data Integrity," DOT/FAA/TC-14/49, dated March 2015. This report is provided for information only and, as such, is not intended as guidance but rather as reference material for the aviation industry. This report may help you assess and select a data integrity algorithm for your specific application and is available through the FAA's William J. Hughes Technical Center internet site at the following address:

<center>

http://www.tc.faa.gov/its/worldpac/techrpt/tc14-49.pdf

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2.   Audience. This AC is directed to applicants, design approval holders, and developers of airborne systems and equipment containing digital data for type certificated aircraft, engines, and propellers pursuant to the provisions of 14 CFR parts 21, 23, 25, 27, 29, 33, and 35.

3.   Effective Date. This AC is effective August 4, 2015.

4.   Related Publications.

    a. FAA Advisory Circulars.

        (1)   AC 20-115C, *Airborne Software Assurance*.

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

        (3)   AC 20-153A, *Acceptance of Aeronautical Data Processes and Associated Databases*.

        (4)   AC 20-156, *Aviation Databus Assurance*.

(5) AC 20-170, *Integrated Modular Avionics Development, Verification, Integration and Approval using RTCA/DO-297 and Technical Standard Order C-153*.

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

(7)   AC 20-174, *Development of Civil Aircraft and Systems*.

(8)   AC 21-50, *Installation of TSOA Articles and LODA Appliances*.

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

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

(11) AC 27-1309, *Equipment, Systems, and Installations* (included in AC 27-1, Certification of Normal Category Rotorcraft).

(12) AC 29-1309, *Equipment, Systems, and Installations* (included in AC 29-2, Certification of Transport Category Rotorcraft).

(13) AC 33.28-1, *Compliance Criteria for 14 CFR §33.28, Aircraft Engines, Electrical and Electronic Engine Control Systems*.

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

(15) AC 33.28-3, *Compliance Criteria for 14 CFR §33.28, Engine Control Systems*.

(16) AC 35.23-1, *Guidance Material for 14 CFR §35.23, Propeller Control System*.

(17) Order 8110.49 Chg 1, *Software Approval Guidelines*.

(18) Order 8110.105 Chg 1, *Simple and Complex Electronic Hardware Approval Guidance*.

b. Industry Documents.

(1)   SAE International Aerospace Recommended Practice (ARP) 4754A, Guidelines for Development of Civil Aircraft and Systems, dated December 21, 2010.

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

(3)   RTCA DO-178C, Software Considerations in Airborne Systems and Equipment Certification, dated December 13, 2011.

(4)   RTCA DO-200A, Standards for Processing Aeronautical Data, dated September 28, 1998.

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

(6)   RTCA DO-297, Integrated Modular Avionics (IMA) Development Guidance and Certification Considerations, dated November 8, 2005.

(7)   RTCA DO-330, Software Tool Qualification Considerations, dated December 13, 2011.

(8)   RTCA DO-331, Model-Based Development and Verification Supplement to DO-178C and DO-278A, dated December 13, 2011.

(9)   RTCA DO-332, Object-Oriented Technology and Related Techniques Supplement to DO-178C and DO-278A, dated December 13, 2011.

(10) RTCA DO-333, Formal Methods Supplement to DO-178C and DO-278A, dated December 13, 2011.

5.   Definition of Key Terms. "Integrity" is defined in this AC as the qualitative or quantitative attribute of a system or an item indicating that it can be relied upon to work correctly. It is sometimes expressed in terms of the probability of not meeting the "work correctly" criteria.

6.   Background. Integrity of digital data is necessary to ensure performance of intended function, and thereby meet the applicable airworthiness regulations. However, airborne systems that have undetected data errors resulting from bit flips or bit shifts due to signal noise, electromagnetic interference, single event effects, or some other anomaly, could have serious operational safety consequences. The standard process used for the System Safety Assessment (SSA) of airborne systems requires that the system designers consider potential failure modes and the effects those failures may have on not only that system, but any "downstream" system that uses data from that system. Airborne systems that use digital technology can experience faults or failures that will result in the loss of integrity of safety related digital data in addition to physical failures of components.

The main methods currently in use to detect errors in digital data are cyclic redundancy codes (CRC) and checksums. The problem that confronts the airborne system designer is that there is very little information available to use in determining the effectiveness of a specific CRC or checksum algorithm for their particular airborne application.

The referenced research report does not provide guidance about how a specific algorithm should be chosen, and the information in the referenced research report should not be considered guidance material. However, the report does provide a discussion of error detection performance metrics, a comparison of various checksum and CRC approaches, and a proposed methodology for mapping CRC and checksum design parameters to aviation integrity requirements.

7.   **Summary.** The FAA is highlighting this research report strictly as reference material that may be helpful to designers of airborne systems that use digital technology. It is not intended as guidance material or policy.

8.   **Where to Find This AC.** You may find this AC at http://www.faa.gov/regulations_policies/advisory_circulars/.

If you have any suggestions for improvements or changes to this AC, you may use the template provided in Appendix A of this AC.

Susan J. M. Cabler
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APPENDIX A. ADVISORY CIRCULAR FEEDBACK INFORMATION

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) complete the form online at https://ksn2.faa.gov/avs/dfs/Pages/Home.aspx or (2) emailing this form to 9-AWA-AVS-AIR-DMO@faa.gov

Subject: AC 00-66   Date: _____

Please check all appropriate line items:

☐   An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐   Recommend paragraph _____ on page _____ be changed as follows:

☐   In a future change to this AC, please cover the following subject:
     (Briefly describe what you want added.)

☐   Other comments:

☐   I would like to discuss the above. Please contact me.

Submitted by: _____ Date: _____

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