U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subj:	QUALITY ASSURANCE OF SOFTWARE USED IN AIRCRAFT OR RELATED PRODUCTS	**Date:** **Initiated by:**	2/3/93 AIR-200	**AC No.:** **Change:**	AC 21-33

1. PURPOSE. This advisory circular (AC) provides an acceptable means, but not the only means, to show compliance with the quality assurance requirements of Federal Aviation Regulations (FAR) Part 21, Certification Procedures for Products and Parts, as applicable to the production of software used in type certificated aircraft or related products (airborne software). This AC also provides supplemental guidance for the establishment of a quality control or inspection ystem to control the development and production of software used in type certifcation aircraft. It supplements AC 21-1, Production Certificates; AC 21-6, Production Under Type Certificate Only; AC 21-20, Supplier Surveillance Procedures; AC 20-115, Radio Technical Commission for Aeronautics Document RTCA/DO-178, and AC 21-303.1, Certification Procedures for Products and Parts.

2. RELATED FEDERAL AVIATION REGULATIONS, ADVISORY CIRCULARS, AND REFERENCE MATERIAL.

a. Part 21, Subpart F, Production Under Type Certificate Only.

b. Part 21, Subpart G, Production Certificates.

c. Part 21, Subpart K, Approval of Materials, Parts, Processes, and Appliances.

d. Part 21, Subpart O, Technical Standard Order Authorizations.

e. AC 20-115, Radio Technical Commission for Aeronautics Document RTCA/DO-178.

f. AC 21-1, Production Certificates.

g. AC 21-6, Production Under Type Certificate Only.

h. AC 21-20, Supplier Surveillance Procedures.

i. AC 21-303.1, Certification Procedures for Products and Parts.

j. Radio Technical Commission for Aeronautics (RTCA), Document No. RTCA/DO-178, Software Considerations in Airborne Systems and Equipment Certification. Copies may be purchased from the RTCA.

3. DISCUSSION. The increased use, criticality, and complexity of software in airborne systems and equipment has dictated that such software be developed, produced, and controlled within a formal systematic environment. Guidance for the orderly development of software for airborne digital computer-based equipment and systems has been provided in RTCA/DO-178 and AC 20-115. Advisory Circulars 21-1, 21-6, 21-20, and 21-303.1 provide a means to obtain and maintain production approvals; however, these documents do not fully cover control of the production of software for airborne digital computer-based equipment and systems used in type certificated aircraft.

4. GENERAL. Manufacturers (and their suppliers) should establish and maintain, as appropriate, a quality control or inspection system that ensures that products used in type certificated aircraft conform to FAA-approved design data and are in condition for safe operation. The quality control and inspection system should include procedures for control of the development and production of software.

NOTE: Words and terms used in the following paragraphs relating to software development and production are defined in RTCA/DO-178.

5. CONTROL OF THE PRODUCTION OF SOFTWARE. Production of software generally involves transferring the bit-representation of software to long-term storage media such as magnetic tape, magnetic disks, or cassettes, or to memory devices such as Read Only Memories (ROMs), Programmable Read Only Memories (PROMs), or magnetic disks. Production approval holders and their suppliers should establish procedures to ensure that the correct software configuration is transferred and that the transferral or copying process is accurately performed. These procedures should include the following as a minimum:

a. Establishment and/or maintenance of software configuration management (SCM) and software quality assurance (SQA) disciplines such as described in RTCA/DO-178, ensuring that the SCM and SQA plans adequately address the SCM and SQA in place for control of the production of software and are in compliance with FAR Part 21. These plans should include, as appropriate:

(1) Methods to ensure that duplication of software for production occurs under controlled conditions and is accurate and repeatable.

(2) Methods to ensure the traceability of the "as-built" configuration to FAA-approved design data.

(3) Methods to control automatic test equipment (ATE) and associated test software used for media verification of appropriate media or memory devices to which the bit-representation of the software has been transferred.

b. Establishment of control for the software media used for transferring the bit-representation to appropriate media or memory devices. In addition to the guidance in RTCA/DO-178, this control should

include clear configuration identification of the software media, and methods for its proper handling, storage, storage retrieval, and preservation.

c. Establishment of control of hardware used in transferring the bit-representation where the quality of the transfer is dependent on the parameters controlled by the hardware.

d. Establishment of media verification methods to ensure that the bit-representation of the software that is transferred to the appropriate media or memory device remains in comp liance with FAA-approved design data. These methods may include the use, for example, of various error-checking codes, either embedded or appended during the transfer process.

e. Identification of records to be used to provide objective evidence that media verification and quality assurance reviews and audits have been satisfactorily accomplished and corrective action applied to areas of noncompliance.

f. Methods for handling, storage, preservation, labeling, packaging, and shipping of the media or completed memory devices to which the bit-representation of the software has been transferred.

6. SUBMITTAL OF QUALITY DATA. Production approval holders required to submit quality data, or changes thereto, to the FAA for approval, should ensure the SQA/SCM plan(s) prepared as part of paragraph 5a above is also submitted for approval. This should be accomplished by submitting SQA/SCM plan(s), with the quality data. The SQA/SCM plan(s) should be reviewed periodically and revised as appropriate to ensure it is current and operational.

Thomas E. McSweeny
Acting Director, Aircraft
Certification Service