



AEROSPACE RECOMMENDED PRACTICE

ARP9034

REV. A

Issued 2003-09
Stabilized 2015-04

Superseding ARP9034

A Process Standard for the Storage, Retrieval and Use of
Three-Dimensional Type Design Data

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

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FOREWORD

This document is the result of a collaborative effort by the AIA Working Team for Storage, Retention and Use of Digital Type Design Data. The Working Team is organized under the Manufacturing Maintenance and Repair Committee of the Civil Aviation Council. The charter of the Working Team is to identify, document and submit for publication an industry consensus standard that defines requirements for a long-term data retention process.

The team includes experts in engineering data management, information technology, configuration management, product data technology, product certification and related fields. This document was developed through a series of workshops where the issues and technologies of long-term data retention were investigated and requirements specific to the retention of type design data were developed.

This document is a consensus standard and needs to be reviewed periodically to ensure that it continues to meet the requirements of the aerospace community.

EXECUTIVE SUMMARY

Many companies are migrating their design technology from traditional two-dimensional drawings to three-dimensional digital models. These three dimensional digital models are not stored on traditional media, such as drawings or microfilm, so new processes are needed to retain type design data represented as three dimensional digital models. Type certificate holders are required to retain type design data for the life of the type certificate, which is often in excess of 50 years. Over these time periods, changes in technology impact the ability to retrieve and use digital data. Type certificate holders who use three-dimensional digital models will need strategies and processes that maintain the usability of the data over multiple generations of technology.

This document describes requirements for standardized processes (and associated technologies) that ensure type design data are retrievable and usable for the life of a type certificate (50+ years). This includes, but is not limited to, digital type design data. The retention process is based on the Open Archival Information System (OAIS) Reference Model, which provides a conceptual framework for archive systems.

The retention process is structured into sub processes for introducing new material into the archive (ingest), managing the data and metadata (data management), managing the physical systems (archive storage), retrieving information and providing it to users (access) and planning the evolution of the repositories (preservation planning). Specific requirements for the retention of type design data are put into this framework.

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1. SCOPE:

This document describes requirements for standardized processes (and associated technologies) that ensure type design data are retrievable and usable for the life of a type certificate (50+ years). These processes are primarily concerned with, but not limited to, digital type design data retained in three-dimensional representations and associated data that is required for complete product definition, such as tolerances, specification call-outs, product structure and configuration control data, etc. This process standard includes process requirements for managing the evolution of technologies required to ensure the availability of the data for the life of the product. This data must be available to meet regulatory, legal, contractual and business requirements.

This process standard is not intended to incorporate every company specific requirement and does not dictate specific organizational structures within a company. This process standard does not specify a design or an implementation. Actual implementations may distribute responsibilities or break out functionality differently.

This document assumes that all requirements for configuration management of the type design data as specified by CFR Title 14, Part 21 [CFR 21] are in place and therefore are not specifically described in this document.

This document sets forth the minimum requirements for product data storage. If an organization chooses to implement requirements beyond those outlined in this standard, those additional requirements shall not conflict or negatively impact the standard requirements. Additional requirements shall also be documented for auditing purposes.

1.1 Purpose:

This process standard establishes the minimum requirements to ensure that digital type design data is stored and maintained such that it is retrievable and usable in accordance with regulatory requirements for the life of a type certificate. This process must address business and legal considerations. The purpose of this standard is to define a process in a way that allows for different implementations based on a company's specific business environment.

2. REFERENCES:

2.1 Applicable Documents:

[AC 2-13] Advisory Circular Checklist, Federal Aviation Administration, Advisory Circular 002.13, June 15, 2000

[AC 21-36] Quality Assurance Controls for Product Acceptance Software, Federal Aviation Administration, Advisory Circular 21-36, August 11, 1993

[CFR 21] Certification procedures for products and parts, Code of Federal Regulations Title 14, Part 21

[DUBLIN] The Dublin Core is a recommended set of metadata attributes documented at <http://www.dublincore.org/>.

[FAA 8000.79] USE OF ELECTRONIC TECHNOLOGY AND STORAGE OF DATA, Federal Aviation Administration Order 8000.79, March 22, 2002.

[OAIS] Reference Model for an Open Archival Information System (OAIS), Consultative Committee for Space Data Systems, CCSDS 650.0-R-2, June 2001

[RTCA] Software Considerations in Airborne Systems and Equipment Certification, RTCA document DO-178B, RTCA, Inc. 1140 Connecticut Avenue, N. W., Suite 1020, Washington, D. C. 20036, March 26, 1999

[SEI-CMMI] CMMI for Systems Engineering/Software Engineering/Integrated Product and Process Development/Supplier Sourcing, Version 1.1, Continuous Representation (CMMI-SE/SW/IPPD/SS, V1.1, Continuous), <http://www.sei.cmu.edu/pub/documents/02.reports/pdf/02tr011.pdf>

[ISO 10303] Industrial Automation systems and integration – Product data representation and exchange, International Organization for Standardization, ISO10303-1: 1994]

[ISO 11179] Information technology- Specification and standardization of data elements, International Organization for Standardization, ISO/IEC FDIS 11179-1:1999]

2.2 Definitions:

ADVISORY CIRCULAR (AC): a document published by the FAA to provide guidance and information in a designated subject area or to show a method acceptable to the (FAA) Administrator for complying with a related Code of Federal Regulation (CFR) [AC 2-13]

ARCHIVAL INFORMATION PACKAGE (AIP): A package of information in an archive system, consisting of the content information and the associated preservation metadata. [OAIS]

ARCHIVED DATA: infrequently accessed data that is stored on long-term storage media.

AUDIT: A periodic review of the repository to verify that the data is secure, uncorrupted, and under configuration control. Audits are performed by an independent party (see definition for "Independence").

AVAILABILITY: the criteria and conditions for approval holders (applicant, manufacturer, etc.) to maintain revise and make accessible the data for the life span of the product. This includes making available, on a routine basis, data the FAA and NTSB need to accomplish activities such as production inspection, surveillance, design changes, incident investigation, and so forth.

CONFIGURATION ITEM: (1) One or more hardware or software components treated as a unit for configuration management purposes. (2) Software life cycle data treated as a unit for configuration management purposes. [RTCA]

CONFIGURATION MANAGEMENT: (1) The process of identifying and defining the configuration items of a product, controlling the release and change of these items throughout the life cycle, recording and reporting the status of configuration items and change requests and verifying the completeness and correctness of configuration items. (2) A discipline applying technical and administrative direction and surveillance to (a) identify and record the functional and physical characteristics of a configuration item, (b) control changes to those characteristics, and (c) record and report change control processing and implementation status. [RTCA]

CYCLIC REDUNDANCY CHECK: A number derived from, and stored or transmitted with, a block of data in order to detect corruption. By recalculating the CRC and comparing it to the value originally transmitted, the receiver can detect some types of transmission errors.

DATA OBJECT: a collection of information that is identified and managed by the retention system. For example, it may be a file in a file system, an identified group of data values such as a solid model, or any other piece of data that is recognized as a managed unit by the retention system.

DESIGN INTENT: the information needed to produce duplicate parts within specified tolerances regardless of the computing representation used to define the part.

DISSEMINATION INFORMATION PACKAGE (DIP): the information package, derived from one or more AIPs, received by the Consumer in response to a request to the archive system. [OAIS]

2.2 (Continued):

DISASTER RECOVERY: the process of managing records, irrespective of media, identified as vital for the purpose of resuming essential business operations following a disaster.

INDEPENDENCE: the separation of responsibilities, which ensures the accomplishment of objective evaluation. (1) For verification process activities, independence is achieved when the verification activity is performed by a person(s) other than the developer of the item being verified, or a tool may be used to achieve equivalence to the human verification activity. (2) For the quality assurance process, independence also includes the authority to ensure corrective action [RTCA].

INHERITED DIGITAL DATA: Data whose ownership has been transferred, e.g., data that was created or maintained outside of an OAIS repository that has been inherited by that repository.

METADATA: data that defines and describes other data [ISO 11179].

MIGRATION: the transfer of digital information, while intending to preserve it, within the OAIS. It is distinguished from transfers in general by three attributes:

- a focus on the preservation of the full information content;
- a perspective that the new archival implementation of the information is a replacement for the old; and
- full control and responsibility over all aspects of the transfer resides with the OAIS [OAIS]

NATIVE REPRESENTATION: the representation of data used by a specific software program. File formats and representations native to a particular software program are often considered proprietary by the software vendor and are not publicly documented.

NEUTRAL REPRESENTATION: a representation of data that is documented independent of a particular software program. Open standards and publicly documented formats and representations are often used as standards for data exchange, e.g., ISO 10303 (STEP).

OPEN ARCHIVAL INFORMATION SYSTEM (OAIS): an archive, consisting of an organization of people and systems that has accepted the responsibility to preserve information and make it available for a designated community. It meets a set of responsibilities that allows an OAIS archive to be distinguished from other uses of the term 'archive'. The term 'Open' in OAIS is used to imply that recommendations and standards are developed in open forums, and it does not imply that access to the archive is unrestricted. [OAIS]

PRODUCT DATA: a representation of information about a product in a formal manner suitable for communication, interpretation, or processing by human beings or by computer. The scope of product data includes the complete product lifecycle, including product design, manufacture, utilization, maintenance and disposal [ISO 10303].

RETENTION PERIOD: the total length of time that product data must be kept before it can be reviewed for disposition. The storage of documentation for a specified period of time determined by legal requirements or business needs.

2.2 (Continued):

RELEASE PROCESS: a process that controls the point at which the approved type design data is authorized for use. A release process is implemented to ensure that data will not be subject to unauthorized change after the data has been approved for release and use.

REPOSITORY: a system for storing, accessing and managing data.

REPRESENTATION: the information that maps a Data Object into more meaningful concepts. An example is the ASCII definition that describes how a sequence of bits (i.e., a Data Object) is mapped into a symbol. [OAIS]

SYSTEM: a collection of related processes and tools.

SYSTEM BACK-UP: data captured for the purpose of restoring data and system software in the event of a system failure.

TRANSLATION: a type of migration where there is some change in the content or representation information bits while attempting to preserve the full information content. [OAIS]

TYPE CERTIFICATE: a certificate issued by a regulatory agency which states that a type design conforms to airworthiness requirements. Each type certificate is considered to include the type design, the operating limitations, the type certificate data sheet, the applicable regulations with which the (FAA) Administrator records compliance, and any other conditions or limitations prescribed for the product. [CFR 21, Section 41].

TYPE DESIGN: the type design consists of [CFR 21, Section 31]:

- a. The drawings and specifications, and a listing of those drawings and specifications, necessary to define the configuration and the design features of the product shown to comply with the requirements of that part of this subchapter applicable to the product;
- b. Information on dimensions, materials, and processes necessary to define the structural strength of the product;
- c. The Airworthiness Limitations section of the Instructions for Continued Airworthiness as required by Parts 23, 25, 27, 29, 31, 33, and 35 of CFR Title 14, or as otherwise required by the (FAA) Administrator; and as specified in the applicable airworthiness criteria for special classes of aircraft defined in Sec. 21.17(b) of CFR Title 14; and
- d. For primary category aircraft, if desired, a special inspection and preventive maintenance program designed to be accomplished by an appropriately rated and trained pilot-owner.
- e. Any other data necessary to allow, by comparison, the determination of the airworthiness, noise characteristics, fuel venting, and exhaust emissions (where applicable) of later products of the same type.

2.2 (Continued):

TYPE DESIGN DATA RETENTION PERIOD: the period of time type design data is retained in support of a type certificate. A type certificate is effective until surrendered, suspended, revoked, or a termination date is otherwise established by the (FAA) Administrator [CFR 21, Section 51].

VITAL RECORD: a business record essential to continuing or recovering company operations following a disaster.

2.3 Terminology:

3D	Three-Dimensional
AC	Advisory Circular
AIA	Aerospace Industries Association
AIP	Archival Information Package
CAD	Computer-Aided Design
CFR	Code of Federal Regulations
CRC	Cyclic Redundancy Check
DIP	Dissemination Information Package
EIA	Electronic Industries Association
FAA	Federal Aviation Administration
ISO	International Standards Organization
NTSB	National Transportation Safety Board
OAIS	Open Archival Information System
PD	Product Data
PLM	Product Life Cycle Management
SIP	Submission Information Package
STEP	STandard for the Exchange of Product model data (ISO 10303)

3. INTRODUCTION:

Many companies are migrating their design technology from traditional two-dimensional drawings to three-dimensional digital models. These three dimensional digital models are not stored on traditional media, such as drawings or microfilm, so new processes are needed to retain type design data represented as three dimensional digital models.

The cost of a particular technology varies over time. As a particular technology ages, the cost of implementation, use, maintenance of that technology can be a large economic pressure to move to a more current technology. Typically, a newer technology also provides additional business benefits, which is not reflected in the figure. At some point, regardless of cost, it may become impractical to use older technology due to lack of materials and support for the technology.

3. (Continued):

Type certificate holders are required to retain type design data for the life of the type certificate, which is often in excess of 50 years. Consequently, it is generally not feasible to maintain a single generation of technology for the entire type design retention period. Over these time periods, changes in technology impact the ability to retrieve and use digital data. Type certificate holders who use three-dimensional digital models will need strategies and processes that maintain the usability of the data over multiple generations of technology.

This document describes requirements for standardized processes (and associated technologies) that ensure type design data are retrievable and usable for the life of a type certificate (50+ years). This includes, but is not limited to, digital type design data. The retention process is based on the Open Archival Information System (OAIS) Reference Model [OAIS] that provides a conceptual framework for archive systems.

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3.1 Conventions:

Within the context of this document the terms “shall” and “may” are used per Code of Federal Regulations (CFR) Title 14 Chapter 1, Part 1:

“Shall” is used in an imperative sense.

“May” is used in a permissive sense to state authority or permission to do the act prescribed, and the words “no person may * * *” or “a person may not * * *” mean that no person is required, authorized, or permitted to do the act prescribed.

“Includes” means “includes but is not limited to”.

4. APPLICATION OF THE OAIS MODEL:

4.1 The Open Archive Information System (OAIS) Reference Model:

The problem of retaining data is not unique to the aerospace industry. In the spacecraft industry, the Consultative Committee for Space Data Systems developed the Reference Model for an Open Archival Information System (OAIS). This model is a framework for describing archiving systems and processes. The OAIS model has been the basis of a number of retention systems in several industries and is considered a mature model. The OAIS functional model is separated into seven functional entities (Common Services, Ingest, Archive Storage, Data Management, Administration, Preservation Planning and Access) and related interfaces. See Figure 1.