UGANDA

Advisory Circular

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GUIDANCE ON VALIDATION AND VERIFICATION OF AERONAUTICAL DATA.

1.0 PURPOSE

This Advisory Circular (AC) provides information and guidance on the establishment and implementation of verification and validation processes for aeronautical data and aeronautical information used in the provision of aeronautical information products such as aeronautical charts.

2.0 REFERENCE

2.1. Regulation 14 of The Civil Aviation (Aeronautical Information Services) Regulations, 2022

2.2. The Civil Aviation (Aeronautical Charts) Regulations, 2022

2.3. ICAO Doc 10066 – PANS AIM

2.4. ICAO Doc 8697 – Aeronautical Chart Manual

2.5. ICAO Doc 9839 – Manual on the Quality Management System for Aeronautical Information Services

2.6. ICAO Doc 8126 – AIS Manual

2.7. ICAO Doc 9674 – World Geodetic System – 1984 (WGS-84) Manual

2.8. Definitions:

Aeronautical data. A representation of aeronautical facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing.

Validation. Confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled.

Verification. Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled.

3.0 GUIDANCE AND PROCEDURES

3.1. General

3.1.1. Regulation 14 of The Civil Aviation (Aeronautical Information Services) Regulations, 2022 require the aeronautical information service provider (AISP) and the aeronautical cartographic service provider (ACSP) to establish validation and verification procedures which ensure that upon receipt of aeronautical data and aeronautical information, quality requirements are met.

3.1.2. The establishment of verification and validation procedures as part of the processing of aeronautical data into aeronautical products ensures that the aeronautical data and aeronautical information submitted to the ACSP as well as the AISP meets the data quality requirements specified in The Civil Aviation (Aeronautical Information Services) Regulations, 2022.

3.1.3. The procedures for verification and validation should be documented in the quality management system (QMS) and all verification and validation activities should be logged in the metadata for traceability.

3.1.4. The application of the verification and validation procedures depends on the integrity classification of the data. For example, critical data elements require a more rigorous application of verification and validation than essential data, whereas routine data requires the least rigorous. If data elements of different integrity classification levels are processed together (e.g. routine data is processed together with essential data), then the higher integrity level should be used for selecting the appropriate verification or validation procedure, unless a more rigorous verification or validation is applied to the more critical data.

3.1.5. Verification and validation activities do not generate data quality per se, but ensure that quality requirements are met and maintained, thereby ensuring the integrity of the data. Since the quality of the data is established at the beginning of the data chain, i.e. at origination, verification and validation procedures should be applied at the beginning and continue throughout all subsequent stages of the data chain.

3.1.6. Good communication between the data originator and the AIS or aeronautical cartographic service is essential. With the required data and its quality specified in the formal arrangement, the originator is responsible for providing data according to the specified requirements and needs to set-up data processes and tools accordingly. The originator is also responsible for verifying and validating the data and subsequently transfers it together with the metadata to the AIS, as specified in the formal agreement. The AIS receives the data and applies its own verification and validation procedures. Thus, the AIS complements, rather than simply duplicates, the quality assurance activities of the data originator.

3.2. Verification

3.2.1. Verifying all aeronautical data and aeronautical information, ensures that the output of the applied processes or actions still conforms to the specified data quality requirements without introducing errors.

3.2.2. Verification activities may include:

a) comparison processes in which data and information are compared with an independent source;
b) feedback processes in which data and information are compared between their input and output state;
c) processing through multiple independent and different systems, comparing the output of each; this includes performing alternative calculations; and
d) processes in which data and information are compared to the originator's request.

3.2.3. Verification also ensures that aeronautical data and aeronautical information has not been corrupted during a transfer.

3.2.4. Digital data error detection techniques that are employed should be based on the use of systematic cycling codes and include the use of hash functions and cyclic redundancy check (CRC). Another technique involves transferring the data back to the originator prior to publication and thereby permitting an external comparison between the output and the input.

3.2.5. Whenever data is entered manually, the data must be verified to ensure that no errors have been introduced. In this case, the verification procedure has to be commensurate with the integrity classification of the data. Assuming a human error rate of 10-3, the following verification procedures should be applied:

a) routine data requires single data entry that is checked at least once;

b) essential data requires the data entry to be independently checked at least once; and
c) critical data requires the data entry to be independently checked twice.

3.2.6. Alternatively, for critical data elements, a verification technique of "blind re-key" may be applied, meaning that a data entry has to be made twice by different individuals with a subsequent comparison check by the automated AIM system.

3.2.7. Whenever geographical coordinates must be transformed, the correct application of the transformation formula should be verified using one of the following techniques:
a) reverse transformation of the output and comparison with the original coordinates;
b) independent calculations using another application or a recognised web-service of a geodetic institute; or
c) manual calculation.

3.2.8. When formatting aeronautical data, the correct application of the data representation rules must be verified. In this case, the verification technique may be to conduct a visual check of the output.

3.2.9. Whenever one or more changes need to be made to a data product, e.g. an AIP Amendment, all the changes must be verified. A verification technique can be to have the originator check the product, or by comparing the changes with the originators' original data submission.

3.2.10. A data element is often portrayed in different data products or in different parts of a particular product (for example, the frequency of a navigational aid is contained in a data set as well as mentioned in different sections of the AIP and displayed on multiple charts). Verification procedures must be consistently applied across a range of different data products.

3.2.11. It is therefore advisable that different data products are generated from a single centralized database with an automated AIM system to ensure consistency across all products. Verification is key to ensuring data quality. All systems and phases for processing of aeronautical data should be designed in a way that each activity, whether manual or automated, is adequately verified and logged using the metadata. Whenever errors are detected during the verification procedure, these errors must be recorded and corrected before proceeding to the next phase.

3.3. Validation

3.3.1. Validating aeronautical data and aeronautical information, confirms and provides assurance that the quality requirements for the intended use are fulfilled. The users of the data rely on the validation performed by the AIS. Data should be validated as early as possible in the data chain. The sooner any non-compliance with the required data quality is discovered, the less costly it is to correct the errors. Any errors detected by the validation activity must be logged and corrected before continuing the processing.

3.3.2. Validation activities may include:
a) application processes in which data and information are tested;
b) processes in which data and information are compared between two different outputs; and
c) processes in which data and information are compared to an expected range, value or other business rules.

3.3.3. Examples of the two complementary types of validation activities are:
a) validation based on metadata; and
b) plausibility check of the data.

3.3.3.1. **Validation based on metadata**

Metadata produced by the data originator is a source of information for the AIS when validating the data. When analysing the incoming data for its fitness for use, the service provider depends on the verification and validation activities done by the originator. The result of these activities is recorded

in the metadata. To validate the data, the service provider checks the metadata received from the originator asking the following questions:

i. Is the data coming from an authoritative source (i.e. is the originator of the data on the list of authorized originators)?
ii. Is the metadata complete and are the accompanying documents unambiguous and comprehensible?
iii. Have all applicable quality requirements, as specified in the formal arrangement (e.g. accuracy, resolution, integrity, format, etc.), been met?

3.3.3.2. **Plausibility checks of the data**

In addition to validating the data based on the metadata, the service provider should apply other methods as well, namely:

i. geographical coordinates can be validated by visualization in a geographic information system. Topographic maps, orthophotos or satellite maps may serve as the geographic reference to compare the data against;
ii. distances and bearings can be checked by recalculating them from geographical coordinates (e.g. route-segments or waypoints);
iii. declared distances can be checked with other runway data such as runway end coordinates, threshold coordinates, runway length and the dimensions of stopways or clearways; and
iv. obstacle data can be checked against digital terrain data in a 3D-viewer, e.g. Google Earth. Thus, erroneous obstacle data can appear to be either embedded within the terrain or floating above it.

3.3.4. **Validation with data from neighbouring States**

In some cases, the same aeronautical data or information is contained in the aeronautical information products and services of two or more States (e.g. common airspace boundaries, routes, waypoints, border points etc.). In those situations, the responsible AIS should establish a mechanism to ensure consistency of the aeronautical data that is common to two or more States. The AIS of the State originating a change that may impact aeronautical data that is common to two or more States should inform the neighbouring AIS to avoid inconsistencies. If data inconsistencies exist at the publication target date, then publication should be postponed. However, if the data has already been distributed according to the aeronautical information regulation and control (AIRAC) system, then corrections must be published by NOTAM.

3.3.5. **Assembling**

3.3.5.1. Data assembled from different originators should be validated for consistency, for example:

i. airspace changes should not be in conflict with neighbouring airspaces;
ii. new routes should fit into the existing route network;
iii. new or modified instrument flight procedures should connect to the existing route network; and
iv. runway thresholds must be consistent with modified instrument approach procedures.

3.3.5.2. Once validated, data collected from the different originators (e.g. aerodrome authority, procedure designers) is assembled into a database which then becomes the authoritative source for all aeronautical information products and services

3.3.6. **Automation systems** implemented for processing aeronautical data and aeronautical information should ensure traceability of the performed actions.

UGANDA CIVIL AVIATION AUTHORITY
DIRECTOR
SAFETY, SECURITY AND ECONOMIC REGULATION

Director Safety, Security and Economic Regulation