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GUIDANCE ON VERIFICATION AND VALIDATION OF AERONAUTICAL CHARTS

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Effective date: ____________________

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Ms. Toska Sem
Executive Director of Civil Aviation

Contents

GUIDANCE ON VALIDATION AND VERIFICATION OF AERONAUTICAL DATA.

1. PURPOSE

This Advisory Pamphlet (AP) 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. BACKGROUND

2.1 The NAM-CAR Part 175 requires that the aeronautical information service provider (AISP) establish validation and verification procedures which ensure that upon receipt of aeronautical data and aeronautical information, quality requirements are met.

2.2 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 ISP meets the data quality requirements specified in the NAMCAR Part 175.

2.3 The procedures for verification and validation should be documented in the Quality Management System (QMS) Manual and all verification and validation activities should be logged in the metadata for traceability.

2.4 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.

2.5 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.

2.6 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 transferring 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 components, rather than simply duplicates, the quality assurance activities of the data originator.

3. EXTRACTS FROM NAMCAR PART 175 – AERONAUTICAL INFORMATION SERVICES

175.05.3 Aeronautical data and aeronautical information verification and validation

An AIS provider must establish procedures and processes for the validation and verification of aeronautical data and aeronautical information in accordance with the standards set out in Document NAM-CATS-AIS.

4. EXTRACTS FROM NAMCATS-AIS – AERONAUTICAL INFORMATION SERVICES

175.05.3 Aeronautical data and aeronautical information verification and validation

1.1 Material to be issued as part of an aeronautical information product must be thoroughly checked before it is submitted to the AIS, in order to ensure that all necessary information has been included and that it is correct in detail.

1.2 An AIS provider must establish verification and validation procedures which ensure that upon receipt of aeronautical data and information, quality requirements are met.

5. Verification

5.1 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.

5.2 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 011tput of each; this includes performing alternative calculations; and
d) processes in which data and information are compared to the originator's request.

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

5.4 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.

5.5 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 a 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.

5.6 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.

5.7 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 recognized web-service of a geodetic institute; or
c) manual calculation.

5.8 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.

5.9 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.

5.10 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.

5.11 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.

6. Validation

6.1 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.

6.2 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.

6.3 Examples of the two complementary types of validation activities are:

a) validation based on metadata; and
b) plausibility check of the data.

7. Validation based on metadata

7.1 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:

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

7.2 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:

(a) geographical coordinates can be validated by visualization in a geographic information system.
(b) Topographic maps, orthophotos or satellite maps may serve as the geographic reference to compare the data against;
(c) distances and bearings can be checked by recalculating them from geographical coordinates (e.g. route-segments or waypoints);
(d) declared distances can be checked with other runway data such as runvvay end coordinates, threshold coordinates, runway length and the dimensions of stopways or clearways; and
(e) 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.

8. Validation with data from neighbouring States

8.1 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.

9. Assembling

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

- (a) airspace changes should not be in conflict with neighbouring airspaces;
- (b) new routes should fit into the existing route network;
- (c) new or modified instrument flight procedures should connect to the existing route network; and
- (d) runway thresholds must be consistent with modified instrument approach procedures.

9.2 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.

9.3 Automation systems implemented for processing aeronautical data and aeronautical information.

10. Validation and verification checklist

10.1 The process of chart validation may be done using a checklist that contains the requirements for a specific chart produced including content, features and measurements. Example of a checklist is illustrated in Appendix 1 and all charts may be done using the same format but with their respective contents.

APPENDIX 1 Charts and Maps Validation Checklist Template

1. AERODROME OBSTACLE CHART — ICAO TYPE A

Feature	Compliant		Remarks
	Yes	No	
1.1 Function • This chart, in combination with the relevant information published in the AIP, must provide the data necessary to enable an operator to comply with the applicable operating limitations specified in the Operation of aircraft regulations			
1.2 Availability • Is the aerodrome Obstacle Charts — ICAO Type A (Operating Limitations) made available, for all aerodromes regularly used by international civil aviation, except for those aerodromes where there are no obstacles in the take-off flight path areas or where the Aerodrome Terrain and Obstacle Chart — ICAO (Electronic) is provided.			
Where a chart is not required because no obstacles exist in the take-off flight path area, a notification to this effect must be published in the AIP.			
1.3 Units of measurement • Elevations must be shown to the nearest half-metre or to the nearest foot.			
• Linear dimensions must be shown to the nearest half-metre			
1.4 Coverage and scale • The horizontal scale must be within the range of 1:10 000 to 1:15 000			

• The vertical scale must be ten times the horizontal scale			
• Horizontal and vertical linear scales showing both metres and feet must be included in the charts			
1.5 Format • The charts must depict a plan and profile of each runway, any			
• The profile for each runway, stopway, clearway and the obstacles in the take-off flight path area must be shown above its corresponding plan.			
• The profile of an alternative take-off flight path area must comprise a linear projection of the full take-off flight path and must be disposed above its corresponding			
• Plan in the manner most suited to the ready interpretation of the information. AND clearway take-off flight path area and			
• A profile grid must be ruled over the entire profile area exclusive of the runway.			
• The zero for vertical coordinates must be mean sea level.			
• The zero for horizontal coordinates must be the end of the runway furthest from the take-off flight path area concerned.			
• Graduation marks indicating the sub-divisions of intervals must be shown along the base of the grid and along the vertical margins			
• The vertical grid may have intervals of 30 m (100 ft) and the horizontal grid may have intervals of 300 m (1 000 ft)			

• The chart must include: a) a box for recording the operational data specified in 3.8.3; b) a box for recording amendments and dates thereof.			
• Identification The chart must be identified by the name of the country in which the aerodrome is located, the name of the city or town or area which the aerodrome serves, the name of the aerodrome and the designator(s) of the runway(s)			
1.5 Obstacles • The profile for each runway, stop way, clearway and the obstacles in the take-off flight path area is shown above its corresponding plan.			
• The profile of an alternative take-off flight path area must comprise a linear projection of the full take-off flight path and must be disposed above its corresponding plan in the manner most suited to the ready interpretation of the information			
1.6 Identification • The chart is identified by the name of the country , the name of the city or town or area which the aerodrome serves, the name of the aerodrome and the designator(s) of the runway(s			
1.7 Plan and profile views The plan view must show the outline of the runways by a solid line, including the length and width, the magnetic bearing to the nearest degree, and the runway number;			
• The outline of the clearways by a broken line, including the length and identification as such;			

• Take-off flight path areas by a dashed line and the centre line by a fine line consisting of short and long dashes;			
• Alternative take-off flight path areas. When alternative take-off flight path areas not centred on the extension of the runway centre line are shown, notes must be provided explaining the significance of such areas;			
• Obstacles, including:			
- obstacle together with a symbol indicative of its type; - the limits of penetration of obstacles of large extent in a distinctive manner identified in the legend.			
• The nature of the runway and stopway surfaces must be indicated			
• Stopways must be identified as such and must be shown by a broken line			
• The profile view must show;			
• The profile of the centre line of the runway by a solid line and the profile of the centre line of any associated stopways and clearways by a broken line;			
• The elevation of the runway centre line at each end of the runway, at the stop way and at the origin of each take-off			
• Stop way and at the origin of each take-off • Obstacles, including: - each obstacle by a solid vertical line extending from a convenient grid line over at least one other grid line to the elevation of the top of the obstacle			

• Identification of each obstacle; the limits of penetration of obstacles of large extent in a distinctive manner identified in the legend			
• Identification of each obstacle; the limits of penetration of obstacles of large extent in a distinctive manner identified in the legend			
1.9 Accuracy • The horizontal dimensions and the elevations of the runway, stop way and clearway on the chart must be determined to the nearest 0.5 m (1 ft			
1.10 Datum • Where no accurate datum for vertical reference is available, the elevation of the datum used must be stated and must be identified as assumed			
Evaluator's Name:	**Signature:**		**Date:**
2. Aerodrome Obstacle Chart – ICAO Type B			
2.1 Function			
• This chart, must provide information to satisfy the following functions: Namibia Civil Aviation Authority - Safety Division a) the determination of minimum safe altitudes/heights including those for circling procedures;			
• The determination of procedures for use in the event of an emergency during take-off or landing; c) the application of obstacle clearing and marking criteria; and			

d) the provision of source material for aeronautical charts			
2.2 Availability • Aerodrome Obstacle Charts — ICAO Type B must be made available, in the manner prescribed in 1.3.2 for all aerodromes regularly used by international civil aviation, except for those aerodromes where the Aerodrome Terrain and Obstacle Chart — ICAO (Electronic) is provided. 4.2.2 When a chart combining the specifications in Section 2 and 3 of this Sub-part is made available, it must be called the Aerodrome Obstacle Chart			
4.3 Units of Measurement • Elevations must be shown to the nearest half-metre or to the nearest foot.			
• Linear dimensions must be shown to the nearest half-metre			
2.4 Coverage and scale • The horizontal scale must be within the range of 1:10 000 to 1:20 000. A horizontal linear scale showing both metres and feet must be included in the chart. - When necessary, a linear scale for kilometres and a linear scale for nautical miles must also be shown.			
2.5 Format The charts must include:			
• Any necessary explanation of the project used;			
• Any necessary identification of the grid used;			

• A notation indicating that obstacles are those which penetrate the obstacle limitation surfaces specified in Part 139			
• Outside the neat line, every minute of latitude and longitude marked in degrees and minutes			
2.5 Identification • The chart must be identified by the name of the country, the name of the city or town or area			
2.6 Culture and Topography • Buildings and other salient features associated with the aerodrome must be shown to scale.			
• Roads and railroads within the take-off and approach area, and less than 600 m (2,000 ft) from the end of the runway or runway extensions, must be shown			
2.7 Identification • The chart must be identified by the name of the country in which the aerodrome is located, the name of the city or town			
• Or area which the aerodrome serves, and the name of the aerodrome			
2.8 Culture and topography • Drainage and hydrographic details must be kept to a minimum			
• Buildings and other salient features associated with the aerodrome must be shown. Wherever possible, they must be shown to scale.			
• All objects, either cultural or natural, that project above the take-off and approach surfaces specified in			

or the clearing and marking surfaces specified in Annex 14, Chapter 4, must be shown.			
• Roads and railroads within the take-off and approach area, and less than 600 m (2 000 ft) from the end of the runway or runway extensions, must be shown			
2.8 Magnetic variation • The chart must show a compass rose orientated to the True North, or a North point, showing the magnetic variation to the nearest degree with the date of magnetic information and annual change.			
2.9 Aeronautical data • The charts show:			
a) the aerodrome reference point and its geographical coordinates in degrees, minutes and seconds			
b) the outline of the runways by a solid line			
c) the length and width of the runway; d) the magnetic bearing to the nearest degree of the runway and the runway number;			
e) the elevation of the runway centre line at each end of the runway, at the stopway, at the origin of each take-off and approach area, and at each significant change of slope of the runway and stop way;			
f) taxiways, aprons and parking areas identified as such, and the outlines by a solid line;			
g) stop ways identified as such and depicted by a broken line;			
h) the length of each stop way;			

i) clearways identified as such and depicted by a broken line;			
j) clearways identified as such and depicted by a broken line;			
k) take-off and approach areas			
2.9 Accuracy			
• The nature of the runway and stop way surfaces may be given a) The order of accuracy of the fieldwork and the precision of chart production resulting in data within the maximum deviations indicated herein: Take-off and approach areas;			
- horizontal distances: 5 m (15 ft) at point of origin increasing at a rate of 1 per 500;			
• Vertical distances: 0.5 m (1.5 ft) in the first 300 m (1 000 ft) and increasing at a rate of 1 per 1 000.			
- Other areas:			
- horizontal distances: 5 m (15 ft) within 5 000 m (15 000 ft) of the aerodrome reference point and 12 m (40 ft) beyond that area;			
- vertical distances: 1 m (3 ft) within 1 500 m (5 000 ft) of the aerodrome reference point increasing at a rate of 1 per 1 000.			
• Vertical distances: 1 m (3 ft) within 1 500 m (5 000 ft) of the aerodrome reference point increasing at a rate of 1 per 1 000.			

Evaluator's Name:	**Signature:**	**Date:**

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