→→→ DRAFT←←←

eTOD Technical and Project Specifications

	Prepared by:	*Reviewed by:*	*Approved by:*
Position			
Signature			
Date			

Scope

This Document describes eTOD technical and project specifications to be developed for the implementation of eTOD by the State.

This Document applies to the Aeronautical Information Service (AIS), those responsible for defining the project, and those offices providing data, including companies hired to capture such data.

The document contains both the technical aspects as well as the necessary elements to execute the project if the State had a terrain and obstacle database (eTOD) that meets both its own needs as well as the requirements of ICAO Annex 15.

It would be almost impossible to address each and all the questions arising during the execution of said project, which would make it necessary to have a very extensive document that would be almost impossible to use. Therefore, it has been decided to generar a document that contains sufficient and useful information for both the organisation and those involved in the project.

Furthermore, it is expected that this will be a dynamic document, to be updated based on the experience acquired during execution.

Control of changes

Document

Coding:	ET
Title:	eTOD Technical and Project Specifications
Owner:	(country) AIS
Master copy location:	AIS (país)
Date of last update:	19/10/2012

Control of Modifications

Date	*Version*	*Reason for the modification*	*Responsible party*
19/10/2012	01	Document definition	SAM/AIM/4

This copy of the Document will be updated each time a new version of the document is released.

Record Sheet and List of Amendments

Amendments

Amendments to this Document must be made by page: replaced, added, deleted, or completely redrafted.

The personnel responsible for amending this Document must complete the following Record of Amendments.

Record of Amendments

Amendment No.	*Date of Amendment*	*Amended by*	*Date*

Table of Contents

SCOPE ..... ERROR! BOOKMARK NOT DEFINED.

CONTROL OF CHANGES ..... ERROR! BOOKMARK NOT DEFINED.

HO RECORD SHEET AND LIST OF AMENDMENTS ..... ERROR! BOOKMARK NOT DEFINED.

REFERENCE DOCUMENTATION ..... ERROR! BOOKMARK NOT DEFINED.

TERMS AND DEFINITIONS ..... ERROR! BOOKMARK NOT DEFINED.

1. BACKGROUND ..... ERROR! BOOKMARK NOT DEFINED.

1.1. SARPS and the new amendments to Annex 15 ..... ***10***
1.2. Application of the new concepts ..... *Error! Bookmark not defined.*
1.2.1. Ground proximity warning systems (GPWS): *10*
1.2.2. Instrument and circling approach procedures *10*
1.2.3. Contingency procedures (other than the existing ones) *11*
1.2.4. Aerodrome obstacle charts (analysis) *11*
1.2.5. Minimum safe altitude warning (MSAW) *11*
1.2.6. Performance-based navigation (PBN) *11*
1.2.7. Advanced surface movement guidance and control system (A-SMGCS) *11*
1.2.8. Search and rescue (especially in mountainous areas) *11*
1.2.9. On-board production of aeronautical charts and databases *11*
1.2.10. Flight simulators ..... ***Error! Bookmark not defined.***
1.2.11. Synthetic display ..... ***Error! Bookmark not defined.***
1.2.12. Restriction and removal of obstacles at aerodromes/heliports *12*
1.3. Benefits ..... *Error! Bookmark not defined.*

2. CONCEPTS **13**

2.1. Terrain ..... *Error! Bookmark not defined.*
2.2. Obstacles ..... *Error! Bookmark not defined.*
2.3. Metadata ***15***
2.4. Reference system ..... *Error! Bookmark not defined.*
2.4.1. Horizontal reference ..... ***Error! Bookmark not defined.***
2.4.2. Vertical reference ..... ***Error! Bookmark not defined.***
2.4.3. Time reference ..... ***Error! Bookmark not defined.***
2.5. Quality criteria ..... *Error! Bookmark not defined.*
2.6. Use of GIS ***18***
2.7. Applicable specifications in accordance with ISO 19131 ..... ***18***

3. TERRAIN SPECIFICATIONS ..... ERROR! BOOKMARK NOT DEFINED.

3.1. Introduction to the product ..... *Error! Bookmark not defined.*
3.1.1. DPS metadata *21*
3.1.2. Terms and definitions ..... ***Error! Bookmark not defined.***
3.1.3. Abbreviations ..... ***Error! Bookmark not defined.***
3.1.4. Informal description of the project *22*
3.2. Field of application of specifications ..... *Error! Bookmark not defined.*
3.2.1. Identification of the scope ..... ***Error! Bookmark not defined.***
3.2.2. Level ..... ***Error! Bookmark not defined.***
3.2.3. Name of level *22*
3.2.4. Extension ..... ***Error! Bookmark not defined.***
3.2.5. Description of level ..... ***Error! Bookmark not defined.***
3.2.6. Coverage ..... ***Error! Bookmark not defined.***

3.3. Identification of the product ..... *Error! Bookmark not defined.*
3.3.1. Title ..... ***Error! Bookmark not defined.***
3.3.2. Alternative title ..... ***Error! Bookmark not defined.***
3.3.3. Abstract *23*
3.3.4. Purpose ..... ***Error! Bookmark not defined.***
3.3.5. Category of the subject matter ..... ***Error! Bookmark not defined.***
3.3.6. Type of spatial representation ..... ***Error! Bookmark not defined.***
3.3.7. Spatial resolution ..... ***Error! Bookmark not defined.***
3.3.8. Geographical description ..... ***Error! Bookmark not defined.***
3.3.9. Supplementary information ..... ***Error! Bookmark not defined.***
3.4. Data content and structure ..... *Error! Bookmark not defined.*
3.4.1. Description of coverage ..... ***Error! Bookmark not defined.***
3.4.2. Type of coverage ..... ***Error! Bookmark not defined.***
3.4.3. Specification (name of role) *24*
3.5. Reference systems ..... *Error! Bookmark not defined.*
3.5.1. Spatial reference system ..... ***Error! Bookmark not defined.***
3.5.2. Temporal reference system ..... ***Error! Bookmark not defined.***
3.6. Quality of data ..... *Error! Bookmark not defined.*
3.6.1. Quality of data ..... ***Error! Bookmark not defined.***
3.7. Data capture ..... *Error! Bookmark not defined.*
3.7.1. Scope of capture ..... ***Error! Bookmark not defined.***
3.7.2. Description of capture ..... ***Error! Bookmark not defined.***
3.8. Maintenance of data ..... *Error! Bookmark not defined.*
3.8.1. Frequency of maintenance and updating *26*
3.9. Portrayal ..... *Error! Bookmark not defined.*
3.9.1. Refrence to the portrayal catalogue *26*
3.10. Provision of the product ..... *Error! Bookmark not defined.*
3.10.1. Name of format ..... ***Error! Bookmark not defined.***
3.10.2. Version *27*
3.10.3. Specification ..... ***Error! Bookmark not defined.***
3.10.4. File structure ..... ***Error! Bookmark not defined.***
3.10.5. Language ..... ***Error! Bookmark not defined.***
3.10.6. Set of characters ..... ***Error! Bookmark not defined.***
3.10.7. Delivery units ..... ***Error! Bookmark not defined.***
3.10.8. Transfer size ..... ***Error! Bookmark not defined.***
3.10.9. Name of the medium ..... ***Error! Bookmark not defined.***
3.10.10. Other information for the delivery *27*
3.11. Additional information ..... *Error! Bookmark not defined.*
3.12. Metadata ***28***

4. OBSTACLE SPECIFICATIONS ..... ERROR! BOOKMARK NOT DEFINED.

4.1. Introduction to the product ..... *Error! Bookmark not defined.*
4.1.1. DPS metadata *29*
4.1.2. Terms and definitions ..... ***Error! Bookmark not defined.***
4.1.3. Abbreviations ..... ***Error! Bookmark not defined.***
4.1.4. Informal description of the product ..... ***Error! Bookmark not defined.***
4.2. Field of application of the specifications ***30***
4.2.1. Identification of the scope ..... ***Error! Bookmark not defined.***
4.2.2. Level ..... ***Error! Bookmark not defined.***
4.2.3. Name of level ..... ***Error! Bookmark not defined.***
4.2.4. Extension ..... ***Error! Bookmark not defined.***
4.2.5. Description of level ..... ***Error! Bookmark not defined.***
4.2.6. Coverage ..... ***Error! Bookmark not defined.***
4.3. Identification of the product ..... *Error! Bookmark not defined.*
4.3.1. Title ..... ***Error! Bookmark not defined.***
4.3.2. Alternative title ..... ***Error! Bookmark not defined.***
4.3.3. Abstract *31*

4.3.4. Purpose ..... ***Error! Bookmark not defined.***
4.3.5. Category of the subject matter ..... ***Error! Bookmark not defined.***
4.3.6. Type of spatial portrayal *31*
4.3.7. Spatial resolution ..... ***Error! Bookmark not defined.***
4.3.8. Geographical description ..... ***Error! Bookmark not defined.***
4.3.9. Supplementary information ..... ***Error! Bookmark not defined.***
4.4. Data content and structure ***32***
4.4.1. Application model - Obstacles *32*
4.4.2. Object catalogue - Obstacle *33*
4.4.3. Supplementary objects ..... ***Error! Bookmark not defined.***
4.4.4. Supplementary atributes of objects *33*
4.5. Reference systems ..... *Error! Bookmark not defined.*
4.5.1. Spatial reference system ..... ***Error! Bookmark not defined.***
4.5.2. Temporal reference system ..... ***Error! Bookmark not defined.***
4.6. Quality of data ..... *Error! Bookmark not defined.*
4.6.1. Quality of data ..... ***Error! Bookmark not defined.***
4.7. Data capture ..... *Error! Bookmark not defined.*
4.7.1. Scope of capture ..... ***Error! Bookmark not defined.***
4.7.2. Description of capture ..... ***Error! Bookmark not defined.***
4.8. Maintenance of data ..... *Error! Bookmark not defined.*
4.8.1. Frequency of maintenance and updating *36*
4.9. Portrayal ***36***
4.9.1. Quote from the portrayal catalogue *36*
4.10. Provision of the product ..... *Error! Bookmark not defined.*
4.10.1. Name of format ..... ***Error! Bookmark not defined.***
4.10.2. Version *37*
4.10.3. Specification ..... ***Error! Bookmark not defined.***
4.10.4. File structure ..... ***Error! Bookmark not defined.***
4.10.5. Language ..... ***Error! Bookmark not defined.***
4.10.6. Set of characters ..... ***Error! Bookmark not defined.***
4.10.7. Delivery units ..... ***Error! Bookmark not defined.***
4.10.8. Transfer size ..... ***Error! Bookmark not defined.***
4.10.9. Name of medium ..... ***Error! Bookmark not defined.***
4.10.10. Other information for the delivery *37*
4.11. Additional information ..... *Error! Bookmark not defined.*
4.12. Metadata ***38***

APPENDIX 1 – ISO 19131:2007 - GEOGRAPHICAL INFORMATION. DATA PRODUCT SPECIFICATIONS 39

Reference Documents

- ICAO Annex 4 – Aeronautical Charts
- ICAO Annex 15 – Aeronautical Information Services
- ICAO Doc 8126 – Aeronautical Information Services Manual
- ICAO Doc 8697 – Aeronautial Chart Manual
- ICAO Doc 8400 – ICAO Abbreviations and Codes
- ICAO Doc 9881 - Guidelines for Electronic Terrain, Obstacle and Aerodrome Mapping Information

Terms and Definitions

The definitions and abbreviations contained in ICAO Doc 8400 – ICAO Abbreviations and Codes are adopted.

Other definitions

AIS-AIM Transition Roadmap:	Plan containing the sequence of tasks for the transition from the current AIS to the new AIM concept
Amendment:	Correction of existing information

Abbreviations

AIM:	Aeronautical information management
AIP:	Aeronautical information publication
AIS:	Aeronautical information service
CAR:	Caribbean Region
eTOD:	Electronic terrain and obstacle data
GIS:	Geographical information system
GPWS:	Ground proximity warning system
ILS:	Instrument landing system
MSAW:	Minimum safe altitude warning
OACI:	International Civil Aviation Organization
PBN:	Performance-based navigation
SAM:	South American Region

Spanish terms and their equivalent in English

Introducción al Producto:	Overview
Campo de aplicación de las Especificaciones:	Specification scope
Identificación del producto:	Data product identification
Contenido y estructura de los Datos:	Data content and structure
Sistemas de referencia:	Reference system
Calidad de datos:	Data quality
Captura de datos:	Data capture
Mantenimiento de los datos:	Data maintenance
Representación:	Portrayal
Suministro del producto:	Data product delivery
Información adicional:	Additional information
Metadatos:	Metadata

1. Background

1.1. SARPs and the new amendments to Annex 15

Traditionally, States have published information on obstacles, always taking into account that they could affect air navigation routes, the areas around the aerodromes, or the take-off and landing flight phases at an aerodrome.

In the case of a detailed portrayal of the terrain, the topographic chart for precision approaches provides precise terrain information. However, the production of that chart was only required if ILS Category II or greater was available.

The remaining charts, in some cases, provide terrain information but details are not as meticulous as in the aforementioned chart.

In short, with the products developed to date, it was not possible to provide full FIR coverage with an adequate level of detail of both obstacles and terrain.

The provision of the digital data required by the industry on both terrain and obstacles led to some modifications to the traditional way in which information was collected and displayed.

Annex 15 through Amendment 33, proposed some major modifications to the collection of both obstacle and terrain data, through the inclusion of Areas 1 to 4 with a view to meeting the aforementioned need.

Subsequently, through Amendment 36, those areas were adjusted, resulting in the creation of Areas, 2a, 2b, 2c, and 2d, resulting in cost savings in the collection of the information required, and in a modification of the dates in which said information would be made available to users. Appendix 8 to ICAO Annex 15 contains a complete description of those areas.

1.2. Application of the new concepts

No doubt these new concepts may be applicated to:

1.2.1. Ground proximity warning systems (GPWS):

The idea is to have a terrain profile that may be used at any point of the terrain, rather than a single value of the minimum sector altitude for a whole area.

1.2.2. Instrument and circling approach procedures

The use of terrain and obstacle profiles is more focused on the centre line of limiting surfaces. In this new way, quality information will be available for both the centre line and any other part of the limiting surface, including missed approaches.

1.2.3. Contingency procedures (other than the existing ones)

In case of occurrence, no mejor effort will be required to obtain the data, since both obstacle and terrain areas will be fuly covered.

1.2.4. Aerodrome obstacle planes (analysis)

Basic understanding of underlying terrain and obstacles by airline operators, and availability of sufficient information for pilots to plan and take emergency action (especially during take-off)

1.2.5. Minimum safe altitude warning (MSAW)

(9881 pag A-5) As a last line of defence, the availability of precise data will be more than beneficial.

1.2.6. Performance-based navigation (PBN)

The inclusion of data on Area 2 (both terrain and obstacles) will be of great help support for the implementation of the PBN concept.

1.2.7. Advanced surface movement guidance and control systems (A-SMGCS)

In accordance with Doc 9830, the SMGCS requires a digital portrayal of the terrain and obstacles at the aerodrome that could affect aircraft and ground vehicle operations. The precision of the collected data will be of greater importance to support this concept.

1.2.8. Search and rescue (especially in mountainous terrain)

Models may provide greater support in this respect, since a DTM for all the territory will be available.

1.2.9. On-board production of aeronautical charts and databases

To the extent on-board charting products and databases start to evolve, it will be an increasing need for digital information. Furthermore, for the remaining aeronautical charts, it will be extremely important for this information to be detailed and precise.

1.2.10. Flight simulators

The use of simulators for personnel training requires precise terrain information, especially when providing training on emergency situations.

1.2.11. Synthetic displays

Although the data collected is not enough to define a synthetic vision of reality (what the pilot can see under VFR conditions), it will be critical to collect the rest of the required data (building facades, etc.)

1.2.12. Restriction and removal of obstacles at aerodromes/heliports

It will be extremely important to have terrain and obstacle (those that penetrate and do not penetrate surfaces) information for the purpose of managing them.

1.3. Benefits

Benefits will be seen mainly with the passage of time, given the impact that this new information will have on the provision of both the traditional products and the new ones that may emerge.

The benefits include a better visualization of the construction of GIS-related procedures, a better visualization of charts together with the metadata, the possibility of applying quality criteria in support of AIM for the provision not only of static AIS products but data as well.

Finally, it will be of great advantage for data exchange (AIXM).

2. Concepts

The precise meaning of the terms is essential for a clear understanding of the information contained in this document. Accordingly, some basic concepts that will be used in the document are described below.

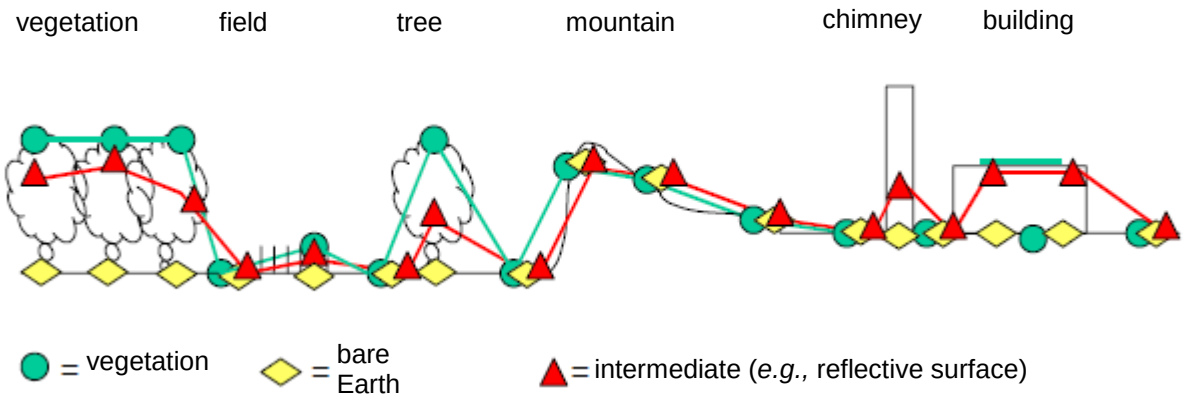
2.1. Terrain

For the purpose of this document, the following definition will be used:

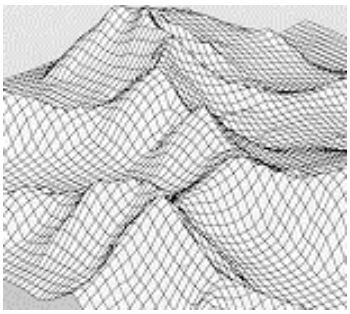
Terrain: The surface of the Earth containing naturally occurring features such as mountains, hills, ridges, valleys, bodies of water, permanent ice and snow, and excluding obstacles.

A terrain database is a digital portrayal of the vertical extension (elevation) of the terrain in a number of discrete points.

Depending on the study source, a terrain database may be envisaged for “bare earth” or “bare earth with cultural features and/or obstacles” (vegetation, buildings, etc.), or for an intermediate surface, resulting from the “reflection” of part of the terrain and obstacles, as shown in the following figure:



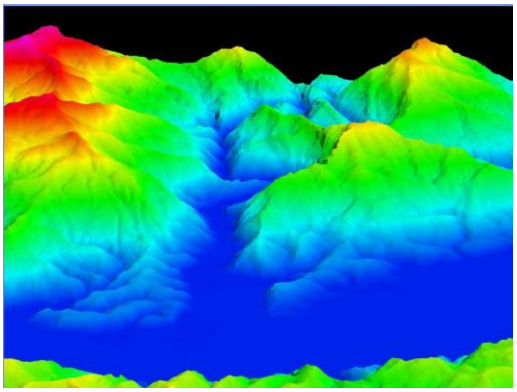
The terrain must be represented by elevation at regular intervals. The result is a digital elevation model.



Elevation grid

Therefore, digital elevation models (DEM) are defined as the 3-D representation of terrain surface by continuous elevation values at all intersections of a defined grid, referenced to a common datum.

As an example, a terrain database represented by a coloured MED is shown below.



MED

2.2. Obstacles

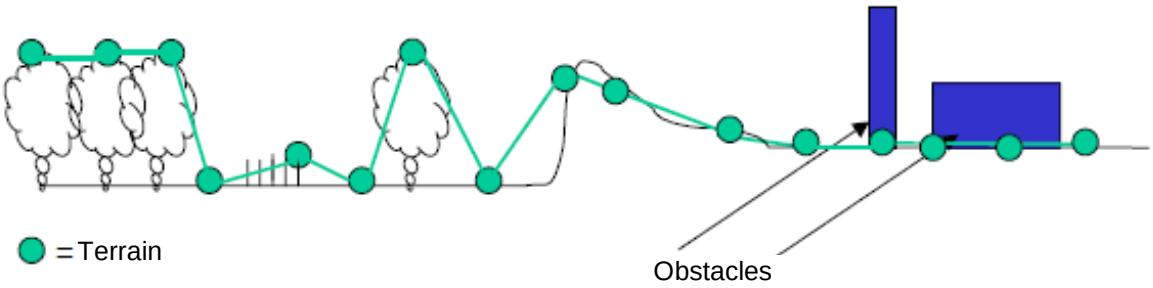
The definition to be used for the document is as follows:

Obstacle: All fixed (whether temporary or permanent) or mobile objects, or parts thereof, that:

a) are located on an area intended for the surface movement of aircraft; or

b) extend above a defined surface intended to protect aircraft in flight; or

c) stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

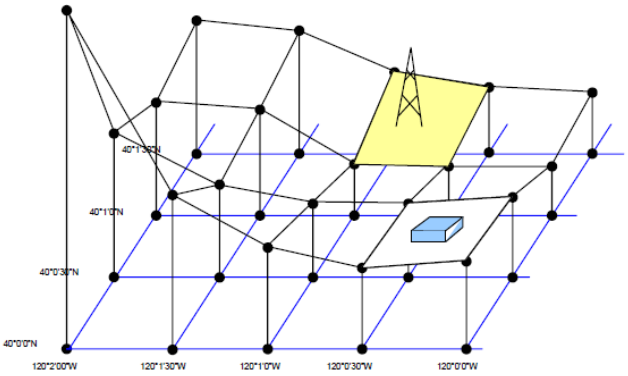


It should be noted that the obstacle concept, depending on its use and the user, could be different from the one set forth herein. For this document, whenever the term “obstacle” is used, it will refer to the aforementioned definition, unless stated otherwise.

An obstacle is an individually identifiable object of a limited spatial extension. Some of the features of the object are captured in the database. Obstacles are not included in a terrain database.

Obstacle data will comprise the digital representation of the vertical and horizontal extension of significant man-made and natural features, such as isolated rocky pillars and natural vegetation (trees).

Obstacle representation on an elevation grid is as follows:



MED with obstacles

2.3. Metadata

In general, metadata is defined as “data on data” or “data defining data”.

Metadata provide information that describes a number of attributes related to a set of actual data.

By way of clarification, it is important to note that product specifications describe what a data set must be, they are defined before production and do not vary through time, while metadata describe what a data set is, they are determined after their production and vary with each new version or update fot he product.

One of the objectives of publishing metadata is to permit the user determine the ability to use a data set with respect to the requirements of a specific application, without having to assess the data itself.

2.4. Reference system

Is defined as a reference to “any amount or set of amounts that may serve as reference or basis for calculating other amounts”.

A ground reference system defines a spatial reference system where the position of a point located on the solid surface of the Earth has coordinates.

The reference system has 3 elements:

- Horizontal reference
- Vertical reference
- Temporal reference

2.4.1. Horizontal reference

The WGS-84 defines a global earth reference system (geodetic datum) and geocentric-referenced ellipsoid. It was developed by the United States Department of Defense, together with scientists of other countries and institutions. Currently, the WGS-84 is the reference system that ICAO requires for georeferencing aeronautical information and will be the one used in this document.

2.4.2. Vertical reference

Mean sea level (MSL), which gives the relationship of gravity-related height (elevation) to a surface known as the geoid, is used as the vertical reference system for international air navigation.

The geoid defined as the equipotential surface in the gravity field of the Earth that coincides with the undisturbed MSL extended continuously through the continents. Gravity-related heights (elevations) are also referred to as orthometric heights while distances of points above the ellipsoid are referred to as ellipsoidal heights.

The Earth Gravitational Model - 1996 (EGM-96), for the purpose of this document, will be used as the global gravity model. In those cases in which the accuracy of EGM-96 does not meet the accuracy requirements for elevation and geoid undulation, regional, national or local geoid models containing high resolution gravity field data will be developed and used.

2.4.3. Temporal reference

Temporal reference systems are used for time-related aeronautical information elements. In this context, time is used to specifically identify the unique moment when an event occurs. A temporal reference system comprises a calendar and time system.

In accordance with Annex 15, Section 3.7.3.1, "For international civil aviation, the Gregorian calendar and coordinate duniversal time (UTC) shall be used as the temporal reference system".

Therefore, the same principle will be applied in this Document.

2.5. Quality criteria

The quality philosophy to be applied for both terrain and obstacle data must reflect a holistic approach based on a set of ISO 19100 standards.

Accordingly, it should be noted that in order to have quality spatial data, such methodology must consider the different stages, from data set design and the required data quality level (both based on the requirements of a specific application), through data quality measurement (quality assessment), to data reporting.

The data quality philosophy comprises the following four topics:

a) Data product specifications (DPS):
A data product specification defines the data product requirements. The content of the DPS is designed to assist potential users to assess the suitability of the data product for its use. The information contained in a DPS is different from that contained in the metadata for the same data set.

b) Quality elements of spatial data:
The quality of data will not only depend on the precision of the data. The following elements must also be considered:
a) Precision: thematic precision, temporal accuracy;
b) Data resolution
c) Integrity

d) Traceability:
e) Integrity: excess, omission:
f) Logical consistency: format consistency, conceptual consistency, domain consistency, topological consistency.

c) Data quality assessment procedures:
A data quality assessment procedure describes the methodology used for applying a data quality measurement to the specified data.

d) Data/metadata quality report
The reporting of data quality assessment results is closely related to metadata.
The objective of each data quality report is to provide sufficient information to enable the end user to determine what has been tested, the way it has been tested, conformity, and the quantitative results of the quality assessment.

2.6. Use of the GIS

Use of the GIS (data access and data exchange)
The provision of terrain and obstacle data in accordance with ISO 19100 enables the delivered data sets to be easily used by the GIS (geographical information system).

A GIS is a set of technological components used for describing real life phenomena in a structured manner. Contrary to other information systems, the GIS highlights the spatial property of a phenomenon.

Therefore, a GIS is used for capturing, maintaining, storing, analysing, managing, and presenting data related to a location. In a more general sense, GIS applications are tools that permit users to create interactive queries (user-created searches), analyse spatial information, edit data, and present the results of all these operations (on the screen or as maps).

2.7. Applicable specifications in accordance with ISO 19131

The specifications of a product are defined as a detailed description of a data set and any additional information required for its production, provision, and use. In other words, it is like a complete and comprehensive description that clearly defines a data set.

The specifications of a product establish user requirements, that is, what is expected of the data set.

For the terrain specification and the obstacle-related data set, the DPS must be based on the structure provided by ISO 19131, and must cover the following topics (mandatory elements in accordance with ISO 19131):

- Introduction to the product:

Informal description of the product and general information on the creation of the DPS. *Definition, content, extent, purpose, sources, production process, metadata description, definitions, maintenance, main characteristics. Reference: Informal*

- Field of application of the specifications:

For each subset of a homogeneous data set, the scope (or foreseen use, coverage) must be proportional. Multiple scopes may be used to distinguish the four areas. *Physical/logical extension (does not neet to be the whole file, could be a layer, an area, or a group of types of phenomena). Reference: ISO19115*

- Product identification:

Product title, a brief summary of the content, purpose, and expected spatial resolution, geographical area covered by the data product; supplementary information, such as legal limitations. *Title, extent, topic, scale, summary, purpose, supplementary information. Referencia: ISO19115*

- Data content and structure:

Application scheme (formal description of the data structure and content of data sets) and feature catalogue (the semantics of all feature types, together with their attributes and attribute value domains, association types between feature types and feature operations, inheritance relations and constraints);

1) Vector file
- *Application model Reference: ISO19109, ISO19137*
- *Catalogue of phenomena Reference: ISO19110*

2) Raster file
- *Identifier*
- *Description*
- *Range of attribute values*
- *Spatial and temporal extension*
- *Type of coverage*

Reference: ISO19123

- Reference systems:

Spatial and temporal reference system
1) Coordinate reference system. Reference: ISO19111
2) Geographical identification reference system. Reference: ISO19112
3) Temporal reference system. Reference: ISO19108

- Data quality:

Acceptable conformity quality and quality of the corresponding data. Quality data elements and sub-elements. *Position, thematic, and logical accuracy, logical consistency, completion (omission and comission), legacy, purpose and use. Reference: ISO19113, ISO19114*

- Data capture:

General description of data sources and data capture processes. *Literal description of the data capture phase and subsequent data handling and editing processes in order to obtain a data set with the required properties. This description must be sufficiently clear and detailed to serve for data set production.*

The best way of documenting such description with precision and in detail is by implementing a quality management system (QMS) that describes all processes and quality controls.

- Data maintenance:

Principles and criteria applied, including update frequency. *Maintenance frequency, next date, scope, contact. Reference: ISO19115*

- Representation:

Information about data representation (graphic output: plot/image). *Representation catalogue, with colours, thicknesses, spot, lineal, and surface symbols, fonts… Reference: ISO19117*

- Product delivery:

Delivery formats and information delivery media. *Native format, supports, and available formats. Reference: ISO19115*

- Additional information

  Information not contemplated in other items:
  + Organisation in sheets
    - *Division, corners*
    - *Sheet nomenclature*

  + Coordinate conversion
  + Units
  + Nº of coordinates
  + Cases
  + Consistency with other products
  + Consistency with other products (MED, raster, orthophoto, files on other countries)
  Reference: ISO19115

- Metadata

  To be included as part of the product. Reference: ISO19115

The catalogue of metadata is based on ISO 19115, and must be adjusted to the requirements of the application.

3. Terrain specifications

The items to be included in the terrain specifications are described below.

3.1. Introduction to the product

3.1.1. DPS metadata

Title of the data set
Title of the data set. May require alignment with the national spatial data infrastructure
Example: Terrain in accordance with data contained in ICAO Annex 15, for <country>.

Date of the reference data set
Date of publication of the DPS
Example: 23/08/2012.

Responsible for the data set
The party responsible for DPS creation.
Example: <Name of the organisation>
<Address>
<Telephone>
<Fax>
<email >
<URL>

Language of the data set
The language in which the DPS and the data set are published.
Example: Spanish.

Data set category
A classification of the data set according to the numbering list provided in MD_TopicCategoryCode of ISO 19115, optionally strengthened with the domain.
Example: 018 - Transportation (Aviation).

3.1.2. Terms and definitions

Important terms used in the DPS may be described in this section. The target audience of the DPS must be taken into account importantes que se utilizan en el DPS puede describirse en esta sección. The target audience of the DPS must be considered when compiling the list of terms (for example, there is no need to explain what a geoid is to inspectors).
Example: Integrity, obstacle, terrain data set, traceability.

3.1.3. Abbreviations

All abbreviations used in this DPS are described in this section.
Example: AIP, AIXM, CRC, ICAO.

3.1.4. Informal description of the product

Given the importance of clearly defining the area for terrain data collection, it will be beneficial to include a detailed description thereof; it would even be advisable to include a graph like those shown in Annex 15, Appendix 8, or those deemed more appropriate.

3.2. Field of application of the specifications

The terrain data set is not homogeneous throughout its length; therefore, consideration must be given to the option of using a subset. The scope of each of these subsets shall be defined.

The following elements must be considered:

3.2.1. Identification of the scope

Identification of the scope for the purpose of a particular data specification
Example: Terrain scope.

3.2.2. Level

The code that identifies the hierarchical level of the data specified by the scope. The MD_ScopeCode numbering of ISO 19115 is used. For a general scope of application, it is assumed to refer to the level of the series. Another level that may be useful within the context of terrain data is the feature type (terrain data).
Example: 006 – series.

3.2.3. Name of level

Name of the hierarchical level of the data specified by the scope of application.
Example: Detail valid for the terrain data of <country>, in accordance with the specifications of ICAO Annex 15.

3.2.4. Extension

Information about spatial, vertical, and temporal extension of the data specified by the scope of application. Information shall be provided only on the horizontal measure of terrain data. A simple description can also be provided,.
Example: The area of <country> and of the adjacent areas, if necessary, for full coverage of Area 2.

3.2.5. Description of the level

Detailed description of the level of the data specified by the scope of application.
Example: The "terrain" level defines the requirements specific to terrain data, and thus deviate from the "general scope".

3.2.6. Coverage

Coverages to which the information applies.
Example: General scope.

3.3. Identification of the product

The examples given for product identification are independent from whether it refers to terrain or an obstacle. For each data application that goes beyond the topographic measurement of a single obstacle, the geographic extension must be documented in this section. Although certain definitions can only be validated by one part of the complete data set, it is proposed that more than one product identification be defined.

3.3.1. Title

The title of the data product.
Example: Terrain data for <país> in accordance with Annex 15.

3.3.2. Alternative title

Another name used for the data product.

3.3.3. Abstract

A brief narrative summary of the content of the data product.
Example: The product contains a terrain data set that meets the requirements established in ICAO Annex 15 (Amendment 36).

3.3.4. Purpose

A summary of the reason for developing the data product.
Example: The purpose of the data product appears in the introduction to Annex 15, Chapter 10, foreseeing the possible use of the data. The user is responsible for determining if the data product meets its needs.

3.3.5. Category of the topic

Specifies to what main topic(s) the data product belongs.
Example: 006 - Elevation
018 - Transportation.

3.3.6. Type of spatial representation

Form of spatial representation.
Example: 002 – grid

3.3.7. Spatial resolution

Factor that provides a general understanding of the density of spatial data in the data set.

3.3.8. Geographical description

Description of the geographical area for which the data are made available. The DPS permits the definition of the geographical extension in a number of different ways, such

as polygons (using Geography Markup Language - GML), selection conditions, or by a geographical identifier (which could be the ISO country code).
Example: SI - Slovenia.

The junction box may be expressed as a polygon coded in GML.
Example:

```
<gml:PolygonsrsName="EPSG:4326">
        <gml:LinearRing>
                <gml: "." coordinates decimal = cs = "," ts = "">
                        119,593002319336, -31,6695003509522
                        119,595306396484, 31,6650276184082
                        119,600944519043, -31,6658897399902
                        119,603385925293, -31,669527053833
                        119,60050201416, -31,6739158630371
                        119,595664978027, -31,6728610992432
                        119,593002319336, 31,6695003509522
                </ gml: coordinates>
        </ gml: LinearRing>
</ gml: Polygon>
```

3.3.9. Supplementary information

Any other descriptive information about the data set

3.4. Data content and structure

This section contains the terrain data model that is required to comply with the SARPs. The terrain information conceptual model (TICM) is a formal representation of terrain data requirements described in ICAO Annex 15, expressed as a set of UML diagrams. Terrain data are modelled in accordance with the coverage scheme of ISO 19123. Terrain model attribute requirements are provided and explained in detail in Annex 15, Appendix 8.

3.4.1. Description of coverage

Technical description of coverage.

3.4.2. Type of coverage

Type of coverage.

3.4.3. Specification (name of role)

Information on additional coverage.

3.5. Reference systems

The spatial reference system used must be a reference coordinate system, as defined in ISO 19111. In accordance with Annex 15, the horizontal datum horizontal is WGS-84, and the

vertical datum is MSL using the appropriate geoid model, such as EGM-96. The Gregorian calendar and coordinated universal time (UTC) shall be used as the temporal reference system.

3.5.1. Spatial reference system

Identifier of the spatial reference system

3.5.2. Temporal reference system

Identifier of the temporal reference system

3.6. Quality of data

Information on the quality of available terrain data sets is vital for the data set selection process, where the data value is directly related to their quality. In order to assess the quality of a data set, clearly defined procedures must be used in a consistent manner. The full description of the quality of a data set will promote the exchange and use of the appropriate geographical data sets.

Annex 5, Appendix 8, contains a set of terrain attributes:

Area of coverage
Data originator identifier
Obstacle identifier
Horizontal accuracy
Horizontal confidence level
Horizontal position
Horizontal resolution
Horizontal extension
Horizontal reference system
Elevation
Elevation reference
Vertical reference system
Vertical resolution
Vertical accuracy
Vertical confidence level
Surface type
Recorded surface
Penetration level
Known variations
Integrity
Date and time stamp
Unit of measurement used

3.6.1. Quality of data

Quality of the information on the data product

3.7. Data capture

The DPS defines the attributes and metadata resulting from the terrain data capture methods that must be communicated. Likewise, data on real life geospatial phenomena and their features must be specified. Data included in this chapter on DPS must include a general description of the data capture process.

Quality conformity levels for intermediate levels that may be necessary for data production may be required.

3.7.1. Scope of capture

Scope of terrain.

3.7.2. Capture description

General description of the data capture procedure.

Example:

The USGS has collected the data set on the national elevation established for public mapping and the use of models in a variety of applications, aviation security being one of them. Terrain data were originally converted from mapping material and aerial photography sobre. The terrain data coordinates were converted from the North American Datum 1983 (NAD-83) to the WGS-84, and were then merged, resampled, quality controlled, and reformatted in the USGS DEM format for delivery.

3.8. Data maintenance

Terrain data sets are increasingly used in dynamic environments for the exchange, sharing, and use for purposes that require both precision and the temporal variable. Ongoing maintenance and updating of specific terrain databases are vital for the applications of the end user.

3.8.1. Frequency of maintenance and updating

Frequency with which changes or additions are made to the product.

3.9. Representation

The terrain DPS provides information on how the products will be presented as graphical output.

3.9.1. Reference to the representation catalogue

Bibliographic reference to the catalogue

3.10. Provision of the product

The DPS does not contain specific requirements for the delivery of data products; however, a DPS implementation will identify the following elements: name of format, version, specification, file structure, language, set of characters, delivery units, transfer size, middle name, and delivery information.

Information on data set formats:

3.10.1. Name of format
Name of the data format

3.10.2. Version
Version of the format (date, number, etc.)

3.10.3. Specification
Name of a subset, profile, or format specification

3.10.4. File structure
Structure of the deliverable file

3.10.5. Language
Language(s) used in the data set

3.10.6. Set of characters
Full name of the character coding standard use for the data set

Information about the medium of the data set to be delivered:

3.10.7. Delivery units
Description of the delivery units (for example, layers, geographical areas)

3.10.8. Transfer size
Estimated size of one unit in the specified format, expressed in Mbytes.

3.10.9. Name of the medium
Name of the medium for the data

3.10.10. Other information for the delivery
Other information relatd to data delivery

3.11. Additional information

This chapter of the DPS may include other aspects of the data product that are not mentioned in any part of the specifications.

3.12. Metadata

The metadata requirements for terrain data products are derived from ISO 19115. metadata are classified as identification information, quality information, maintenance information, spatial representation information, reference information of the information distribution system, measurement information, and reference information.

4. Obstacle specifications

The items that must be included in obstacle specifications are described below.

4.1. Introduction to the product

4.1.1. DPS metadata

Title of the data set
The title of the data set. Alignment with the national infrastructure of spatial data may be required.
Example: Obstacles in accordance with the data contained in ICAO Annex 15 for <country>.

Date of the reference data set
Date in which the DPS was published.
Example: 23/08/2012.

Responsible for the data set
The party that is responsible for the creation of the DPS.
Example: <Name of the organisation>
<Address>
<Telephone>
<Fax>
<email >
<URL>

Language of the data set
The language in which the DPS and the data set are published.
Example: Spanish.

Data set category
A data set classification in accordance with the numbering list contained in MD_TopicCategoryCode of ISO 19115, optionally supported by the domain.
Example: 018 - Transportation (Aviation).

4.1.2. Terms and definitions

Important terms used in the DPS may be described in this section. The target audience of the DPS must be taken into account when compiling the list of terms (for example, there is no need to explain a geoid to inspectors).
Example: Integrity, obstacle, terrain data set, traceability.

4.1.3. Abbreviations

All abbreviations used in the DPS are described in this section.
Example: AIP, AIXM, CRC, ICAO.

4.1.4. Informal description of the product

Given the importance of clearly defining the area for obstacle data collection, it will be beneficial to include a detailed description thereof; it would even be advisable to include a graph like those shown in Annex 15, Appendix 8, or those deemed more appropriate.

4.2. Field of application of the specifications

Taking into account item 3.2 of this document, which contains a diagrame that is also valid for obstacles, the following scenarios shall be taken into account for defining them:

4.2.1. Scope identification

Identification of the scope for a given data specification
Example: Scope of obstacles.

4.2.2. Level

The code that identifies the hierarchical level of the data specified in the scope. ISO 19115 MD_ScopeCode numbering is used. For general application, it is assumed that it refers to the series level. Another level that may be useful within the context of terrain data is the feature type (Area 1 obstacle).
Example: 006 – series.

4.2.3. Level name

Name of the hierarchical level of the data specified by the scope.
Example: Detail valid for terrain data for <country>, as specified in ICAO Annex 15

4.2.4. Extension

Information about the spatial, vertical, and temporal extension of the data specified by the scope. The information will be provided only on the horizontal measure for terrain data. A simple description may also be provided.
Example: The area of <country> that defines Area 1.

4.2.5. Description of the level

Detailed description of the level of the data specified by the scope.
Example: "Obstáculo Área 1" scope level defines the requirements that are specific for obstacles in Area 1 and, thus, deviate from the "General Scope" and the "obstacle scope ".

4.2.6. Coverage

Coverages to which this information applies:
General scope.

4.3. Product identification

As indicated in 3.3, this section is independent from whether it is terrain or obstacle data. Accordingly, it shall be used as follows:

4.3.1. Titile

Title of the data product.
Example: Terrain data for <country> in accordance with Annex 15.

4.3.2. Alternative title

Another name by which the data product is known.

4.3.3. Abstract

A brief narrative summary of the content of the data product.
Example: The product contains a terrain data set that meets the requirements established in ICAO Annex (Amendment 36).

4.3.4. Purpose

A summary of the idea behind the development of the data product.
Example: The purpose of the data product is described in the introduction to Annex 15, Chapter 10, which indicates the possible uses of the data. The user is responsible for determining whether the data product meets its needs.

4.3.5. Topic category

Specifies what main topic(s) the data product belongs to.
Example: 006 - Elevation
018 - Transportation.

4.3.6. Type of spatial representation

Form of spatial representation.
Example: 002 – Grid

4.3.7. Spatial resolution

Factor that provides a general understanding of the density of spatial data in the data set.

4.3.8. Geographical description

Description of the geographical area for which data are made available. DPS permits the definition of the geographical extension in a number of different ways, such as polygons (using Geography Markup Language - GML), selection conditions, or by a geographical identifier (which could be an ISO country code).
Example: SI - Slovenia.

The junction box may be expressed as a polygon, coded in GML.
Example:

```
<gml:PolygonsrsName="EPSG:4326">
        <gml:LinearRing>
                <gml: "." coordinates decimal = cs = "," ts = "">
                        119,593002319336, -31,6695003509522
                        119,595306396484, 31,6650276184082
                        119,600944519043, -31,6658897399902
                        119,603385925293, -31,669527053833
                        119,60050201416, -31,6739158630371
                        119,595664978027, -31,6728610992432
                        119,593002319336, 31,6695003509522
                </ gml: coordinates>
        </ gml: LinearRing>
</ gml: Polygon>
```

4.3.9. Supplementary information

Any other descriptive information about the data set

4.4. Data content and structure

The exchange of obstacle data must comply with the application model and the object catalogue shown below.

4.4.1. Application model - Obstacles

The application model provides the common data model for obstacle data products and complies with ISO 19109

This model reflects the requirements specified in Annex 15 and, thus, may be used by system implementers to establish conforming data exchange processes and formats. However, the application model is not intended to impose a particular model but rather to identify and standardise all common obstacle features and attributes, thus allowing the exchange of standard information.

The use of the ISO 19100 series for geographical information as a frame of reference for data modelling implies adhering to a common methodology to ensure interoperability.

Therefore, the types available in ISO 19100 will be used as required. Furthermore, in the case of metadata, the data structure has been derived from the abstract metadata specification contained in ISO 19115.

The application scheme has been structured in two higher-level packages: object types and metadata types. Object types reflect obstacle features and use the attribute types and the types of ISO 19100 to define attributes and geometries.

4.4.2. Object catalogue - Obstacle

This catalogue was developed in accordance with ISO 19110 and provides the minimum required set of attributes to be used. Attribute values, both the label and the code, must be provided in the file to be exchanged.

4.4.3. Supplementary objects

The object catalogue provides the optional and mandatory features and the attributes that may be included in a data set. Although it is expected that they will meet most applications, more attributes and supplementary attributes may be added.

In order to use supplementary attributes, specific standards related to the denomination convention and function of the mandatory information will be used. Each supplementary attribute may be described in a data exchange report file. In the event of using supplementary attributes, the following information must be used: attribute name, attribute description, geometry type, derivation method, and the data capture rule.

In order to use supplementary attributes and new attributes, the object catalogue must be modified using ISO 19131.

4.4.4. Supplementary object attributes

In case of using supplementary attributes, the following must be provided:

4.4.4.1. Object type
Textual description of the object type

4.4.4.2. Obstacle identification
Function-specific identifier

4.4.4.3. Data originator identifier
Name of the entity or organisation where the data provided originates. In the case of data being originated for the first time, the name of the author of the data shall be included.

4.4.4.4. Geometry
Characteristics of the point, line, or polygon, respectively

4.4.4.5. Elevation
Maximum elevation of the top of the object

4.4.4.6. Height
The maximum height of the top of the object

4.4.4.7. Horizontal extension
Radius of the circle around the centre of the object, including the object body and the associated structures, such as tensioning cables.

4.4.4.8. Horizontal precision

Horizontal precision of the recorded position

4.4.4.9. Horizontal confidence level

The probability that the recorded value falls within the stated horizontal accuracy of the actual value

4.4.4.10. Vertical precision

The vertical accuracy of the object elevation

4.4.4.11. Vertical confidence level

The probability that the recorded value falls within the stated vertical aaccuracy of the actual value

4.4.4.12. Integrity

Data integrity is the degree of certainty that the data and their value have not been lost or altered since their origination or modified without authorisation.

4.4.4.13. Date-hour

Date or origination or last revision of the data

4.4.4.14. Effectiveness

Date-hour of construction, assembly, disassembly, or elimination

Attributes other than the aforementioned may be added. They shall be referenced to ISO 19131.

4.5. Reference systems

The spatial reference system used must be a reference coordinate system as defined in ISO 19111. In accordance with Annex 15, the horizontal datum is WGS-84, and the vertical datum is MSL, using the appropriate geoid model, such as EGM-96. The temporal reference system will be the Gregorian calendar and coordinated universal time (UTC).

4.5.1. Spatial reference system

Spatial reference system identifier

4.5.2. Temporal reference system

Temporal reference system identifier

4.6. Data quality

Information about the quality of obstacle data sets is vital for the data set selection process, in which the value of the data is directly related to its quality. In order to assess the

quality of a data set, clearly defined procedures must be used consistently. The full description of the quality of a data set will encourage the exchange and use of the appropriate geographical data sets.

Annex 5, Appendix 8, contains a set of obstacle attributes:

Area of coverage
Data originator identifier
Obstacle identifier
Horizontal accuracy
Horizontal confidence level
Horizontal position
Horizontal resolution
Horizontal extension
Horizontal reference system
Elevation
Height
Vertical accuracy
Vertical confidence level
Elevation reference
Vertical resolution
Vertical reference system
Obstacle type
Geometry type
Integrity
Date and time stamp
Unit of measurement used
Operations
Effectivity
Lighting
Marking

4.6.1. Quality of data

Quality of the information about the data product

4.7. Data capture

The DPS defines the attributes and metadata whereby the results of the obstacle data capture methods may be communicated. Likewise, the data on real-world geospatial phenomena and their characteristics must be specified. The information contained in this DPS chapter must include a general description of the data capture process.

The quality conformity levels of intermediate data that may be required for data production may be required.

4.7.1. Capture scope

Obstacle scope

4.7.2. Description of the capture

General description of the obstacle capture procedure.

Example:

The global obstacle data set uses updated data received electronically, as well as digitalised data from updated mapping sources.

4.8. Data maintenance

Obstacle data sets are increasingly used in dynamic environments: for the exchange, sharing, and utilisation for purposes that require both precision and temporal variable relevance. Ongoing maintenance and updating of specific terrain databases is vital for the application process of the end user.

4.8.1. Maintenance and updating frequency

Frequency with which changes and additions are made to the product

4.9. Representation

The obstacle DPS provides information about how data will be presented as a graphical output.

4.9.1. Reference to the representation catalogue

Bibliographic reference in the representation catalogue

4.10. Product delivery

The DPS does not contain specific requirements for the delivery of data products. However, a DPS implementation will identify the following elements: name of the format, version, specification, file structure, language, character set, delivery units, transfer size, middle name, and delivery information.

Information about the format of the data set to be delivered:

4.10.1. Name of the format
Name of the data format

4.10.2. Version
Format version (date, number, etc.)

4.10.3. Specification
Name of a format subset, profile, or specification

4.10.4. File structure
Structure of the deliverable file

4.10.5. Language
Language(s) used in the data set

4.10.6. Set of characters
Complete name of the character coding standard used for the data set

Information about the medium of the data set to be delivered:

4.10.7. Delivery units
Description of the delivery units (*e.g.,* layers, geographic areas)

4.10.8. Transfer size
Estimated size of a unit in the specified format, expressed in Mbytes

4.10.9. Name of the medium
Name of the medium for the data

4.10.10. Other information about the delivery
Other information related to data delivery

4.11. Additional information

This chapter of the DPS may include other aspects of the data not contained in any other part of the specifications.

4.12. Metadata

Metadata requirements of obstacle data products are derived from ISO 19115. Metadata are classified as identification information, quality information, maintenance information, spatial representation information, reference information of the information distribution system, measurement information, and reference information.

Appendix 1 – ISO 19131:2007 – Geographical information. Data product specifications

This international standard describes the specification requirements for geographical data products, based on the concepts contained in other ISO 19100 international standards. It describes the content and structure of a data product specification. It also provides assistance for the creation of data product specifications so that they may be easily understood and customised as required.

A data product specification is a detailed description of a data set or a series of data sets, with additional information on its creation, provision, and use. It is a precise technical description of the data product in terms of the requirements it will or might meet. It serves as the basis for data production or acquisition. It may also assist possible users in the assessment of the data product in order to determine its useability.

The specification information about the data product may be used to create metadata for a particular data set that is created in accordance with the data product specification. However, the information contained in a data product specification is different from that contained in the metadata. Metadata provide information about a physical data set in particular; the data product specification only defines how the data set should be. For various reasons, some implementation adjustments may be required.

Metadata related to the product data set should reflect the current status of the product data set.

A data product specification may be created and used on various occasions, by different parties, and for various reasons. For example, it may be used for the original data collection process as well as for products derived from existing data. It may be created by producers to specify their product or by users to determine their requirements.

A data product specification does not need to describe the production process, but only the resulting data product. However, it may include production and maintenance aspects if deemed necessary to describe the data product.

A data product specification contains main sections that cover the following aspects of the data product:

- General — Clause 7
- Scope of the specification — Clause 8
- Data product identification — Clause 9
- Data content and structure — Clause 10
- Reference systems — Clause 11
- Quality of data — Clause 12
- Metadatos — Cláusula 18.

A data product specification may also contain sections covering the following aspects of the data product:

- Data capture — Clause 13
- Data maintenance — Clause 14
- Graphic representation — Clause 15
- Additional information — Clause 17.

The minimum description of a data product contains mandatory elements in each section.