**INTERNATIONAL HYDROGRAPHIC ORGANIZATION**



**IHO GEOSPATIAL STANDARD**

**FOR CATALOGUE OF NAUTICAL PRODUCTS**

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Catalogue of Nautical Products - Product Specification

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**Revision History**

Changes to this Product Specification are coordinated by the IHO Nautical Information Provision Working Group (NIPWG). New editions will be made available via the IHO web site. Maintenance of the Product Specification shall conform to IHO Technical Resolution 2/2007 (revised 2010).

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# Overview

## Introduction

This document has been produced by the IHO Nautical Information Provision Working Group (NIPWG) in response to a requirement to produce a data product that can be used as a Nautical Publication Overlay (NPIO) within an Electronic Chart Display and Information Systems (ECDIS). It is based on the IHO S-100 framework specification and the ISO 19100 series of standards. It is a vector product specification that is primarily intended for encoding the status and extent of Catalogue of Nautical Products, for navigational purposes.

Catalogue of Nautical Products (CNP) datasets describe the availability and reliability of paper chart, ENC, S-100 based nautical products, application for navigational purpose, online service and e-Navigation service. This includes their issue date, publication status, producing agency, source indication. CNP is intended to exchange status of nautical products and to be a supplement to ENC, and therefore does not describe the geographic information in detail equal to ENC, rather it is shown as a coverage of nautical products.

#  Reference

## Normative

The following normative documents contain provisions that, through reference in this text, constitute provisions of this document.

IHO S-100 IHO Universal Hydrographic Data Model Edition 3.0.0 (April 2017).

ISO 8601. 2004. *Data elements and interchange formates - Information interchange - Representation of dates and times.* 2004.

ISO 3166-1. 1997**.** *Country Codes.* 1997.

ISO 19101-2:2008 Geographic Information - Rules for Application Schema

ISO/TS 19103:2005 Geographic Information - Conceptual schema language

ISO 19106:2004 Geographic Information - Profiles

ISO 19107:2003 Geographic Information – Spatial schema

ISO 19109:2005 Geographic Information - Rules for Application Schema

ISO 19111:2003 Geographic information - Spatial referencing by coordinates

ISO 19115:2003+Corr1 (2006) Geographic Information - Metadata

ISO 19115-2:2009 Geographic information - Metadata: Extensions for imagery and gridded data

ISO 19123:2005 Geographic information - Schema for coverage geometry and functions

ISO 19129:2009 Geographic information - Imagery gridded and coverage data framework

ISO 19131:2007 Geographic information - Data product specifications

ISO 19136:2007 Geographic Information – Geography Markup Language

ISO 19136-2:2015, Geographic Information – Geography Markup Language.

ISO/TS 19139, Geographic Information – Metadata – XML schema implementation.

## Normative

The following informative documents provide additional information, including background information, but are not required to develop applications for data conforming to this specification.

ISO/IEC 19757-3, Information technology – Document Schema Definition Languages (DSDL) – Part 3: Rule-based validation – Schematron.

IHO S-101 IHO Electronic Navigational Chart Product Specification (release date TBD).

# Terms, Definitions and Abbreviations

## Terms and Definitions

The S-100 framework is based on the ISO 19100 series of geographic standards. The terms and definitions provided here are used to standardize the nomenclature found within that framework, whenever possible. They are taken from the references cited in clause 2.1. Modifications have been made when necessary.

**application**

manipulation and processing of data in support of user requirements (ISO 19101)

**application schema**

**conceptual schema** for data required by one or more **applications** (ISO 19101)

**conceptual model**

modelthat defines concepts of a **universe of discourse** (ISO 19101)

**conceptual schema**

formal description of a **conceptual model** (ISO 19101)

**coverage**

**feature** that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal **domain** (ISO 19123)

*EXAMPLE Raster image, polygon overlay, digital elevation matrix.*

**data product**

**dataset** or **dataset series** that conforms to a **data product specification**

**data product specification**

detailed description of a **dataset** or **dataset series** together with additional information that will enable it to be created, supplied to and used by another party

*NOTE: A data product specification provides a description of the universe of discourse and a specification for mapping the universe of discourse to a dataset. It may be used for production, sales, end-use or other purpose.*

**dataset**

identifiable collection of data (ISO 19115)

*NOTE: A dataset may be a smaller grouping of data which, though limited by some constraint such as spatial extent or feature type, is located physically within a larger dataset. Theoretically, a dataset may be as small as a single feature or feature attribute contained within a larger dataset. A hardcopy map or chart may be considered a dataset.*

**dataset series**

collection of **datasets** sharing the same product specification (ISO 19115)

**domain**

well-defined set (ISO/TS 19103)

*NOTE: Well-defined means that the definition is both necessary and sufficient, as everything that satisfies the definition is in the set and everything that does not satisfy the definition is necessarily outside the set.*

**feature**

abstraction of real world phenomena (ISO 19101)

*NOTE: A feature may occur as a type or an instance. Feature type or feature instance shall be used when only one is meant.*

**feature association**

relationship that links instances of one **feature** type with instances of the same or a different **feature** type (ISO19110)

*NOTE 1; A feature association may occur as a type or an instance. Feature association type or feature association instance is used when only one is meant.*

*NOTE 2: Feature associations include aggregation of features.*

**feature attribute**

characteristic of a **feature** (ISO 19101)

*NOTE 1: A feature attribute may occur as a type or an instance. Feature attribute type or feature attribute instance is used when only one is meant.*

*NOTE 2: A feature attribute type has a name, a data type and a domain associated to it. A feature attribute for a feature instance has an attribute value taken from the domain.*

**geographic data**

data with implicit or explicit reference to a location relative to the Earth (ISO 19109)

*NOTE: Geographic information is also used as a term for information concerning phenomena implicitly or explicitly associated with a location relative to the Earth.*

**metadata**

data about data (ISO 19115)

**model**

abstraction of some aspects of reality (ISO 19109)

**portrayal**

presentation of information to humans (ISO 19117)

**quality**

totality of characteristics of a product that bear on its ability to satisfy stated and implied needs (ISO 19101)

**universe of discourse**

view of the real or hypothetical world that includes everything of interest (ISO 19101)

## Abbreviations

This product specification adopts the following convention for symbols and abbreviated terms:

ASCII American Standard Code for Information Interchange
ECDIS Electronic Chart Display and Information Systems
ENC Electronic Navigational Chart
GML Geography Markup Language
IHO International Hydrographic Organization
IOC International Oceanographic Commission
ISO International Organization for Standardization
NIPWG Nautical Information Provision Working Group
NPIO Nautical Publication Information Overlay
UML Unified Modelling Language
URI Uniformed Resource Identifier
URL Uniform Resource Locator
WMS Web Map Service
WFS Web Feature Service
www World Wide Web
WGS World Geodetic System
XML Extensible Markup Language
XSLT eXtensible Stylesheet Language Transformations

## Use of Language

Within this document, including appendices and annexes:

* “Must” indicates a mandatory requirement.
* “Should” indicates an optional requirement, that is the recommended process to be followed, but is not mandatory.
* “May” means “allowed to” or “could possibly”, and is not mandatory.

## UML Notations

In this document, conceptual schemas are presented in the Unified Modelling Language (UML). Several model elements used in this schema are defined in ISO standards or in IHO S-100 documents. In order to ensure that class names in the model are unique ISO TC/211 has adopted a convention of establishing a prefix to the names of classes that define the TC/211 defined UML package in which the UML class is defined. Since the IHO standards and this product specification make use of classes derived directly from the ISO standards. This convention is also followed in this document. In the IHO standards class names are identified by the name of the standard, such as "S100" as the prefix optionally followed by the bi-alpha prefix derived from ISO standard. For the classes defined in this product specification the prefix is "S-128". In order to avoid having multiple classes instantiating the same root classes, the ISO classes and S-100 classes have been used where possible; however, a new instantiated class is required if there is a need to alter a class or relationship to prevent a reverse coupling between the model elements introduced in this document and those defined in S-100 or the ISO model.

# Specification Description

## Informal Description of Data Product

This clause contains general information about the data product.

**Title:** Catalogue of Nautical Products Product Specification

**Abstract:** Catalogue of Nautical Products (CNP) datasets describe the availability and reliability of paper chart, ENC, S-100 based nautical products, application for navigational purpose, online service and e-Navigation services. This includes their issue date, publication status, producing agency, source indication. CNP is intended to exchange status of nautical products and to be a supplement to ENC, and therefore does not describe the geographic information in detail equal to ENC, rather it is shown as a coverage of nautical products.

**Content:** Datasets conforming to this specification will contain catalogue of all relevant nautical products information for the area of coverage such as paper chart, ENC, Nautical publication, S-100 based nautical products and e-Navigation services.

**Spatial Extent:** Global coverage of maritime areas.

**Specific Purpose:** Describing status of nautical products, and to allow the producer to exchange catalogue of nautical products with interested stakeholders.

## Data product specification metadata

This information uniquely identifies this Product Specification and provides information about its creation and maintenance. For further information on dataset metadata see the metadata clause.

**Title:** Catalogue of Nautical Product

**S-100 Version**: 4.0.0

**S-128 Version**: 0.7.5

**Date**: 2019-11-20

**Language**: English

**Classification**: Unclassified

**Contact**: International Hydrographic Bureau,
 4 quai Antoine 1er,
 B.P. 445
 MC 98011 MONACO CEDEX
 Telephone: +377 93 10 81 00
 Telefax: + 377 93 10 81 40

**URL**: http://www.iho.int

**Identifier**: S-128

**Maintenance**: Amendments to this specification will be produced on a needs basis. For reporting issues with this specification which need correction, use the contact information.

## Product Specification Maintenance

### Introduction

Changes to S-128 will be released by the IHO as a new edition, a revision, or as a document that includes clarification. These are described below.

### New Edition

New Editions introduce significant changes. New Editions enable new concepts, such as the ability to support new functions or applications, or the introduction of new constructs or data types. New Editions are likely to have a significant impact on either existing users or future users of S-128.

### Revisions

Revisions are defined as substantive semantic changes. Typically, revisions will introduce change to correct factual errors; introduce necessary changes that have become evident as a result of practical experience or changing circumstances. A revision must not be classified as a clarification. Revisions could have an impact on either existing users or future users this specification. All cumulative clarifications will be included with the release of approved corrections revisions.

Changes in a revision are minor and ensure backward compatibility with the previous versions within the same Edition. Newer revisions, for example, introduce new features and attributes. Within the same Edition, a dataset of one version could always be processed with a later version of the feature and portrayal catalogues. In most cases a new feature or portrayal catalogue will result in a revision of this specification.

### Clarification

Clarifications are non-substantive changes. Typically, clarifications: remove ambiguity; correct grammatical and spelling errors; amend or update cross references; insert improved graphics in spelling, punctuation and grammar. Clarification must not cause any substantive semantic changes.

Changes in a clarification are minor and ensure backward compatibility with the previous versions within the same Edition. Within the same Edition, a dataset of one clarification version could always be processed with a later version of the feature and portrayal catalogues, and a portrayal catalogue can always rely on earlier versions of the feature catalogues.

Changes in a clarification are minor and ensure backward compatibility with the previous versions

### Version Numbers

The associated version control numbering to identify changes (n) to this specification must be as follows:

New Editions denoted as **n**.0.0

Revisions denoted as n.**n**.0

Clarifications denoted as n.n.**n**

## Specification Scope

This product specification describes one data product and therefore requires only one scope which is described below:

**Scope ID:** Catalogue of Nautical Product

**Hierarchical level:** MD\_ScopeCode – 005 (dataset)

**Hierarchical level name:** CNP Dataset

**Level description:** information applies to the dataset

**Extent:** EX\_Extent.description: Global coverage of maritime areas

# Data product identification

This section describes how to identify data sets that conform to the specification. A dataset that conforms to this Product Specification may be identified by its discovery metadata as defined in clause 12 of this specification. The information identifying the data product may include the following items from S-100 3.0.0 clause 11-6 (adapted from ISO 19115).

|  |  |
| --- | --- |
| **title** | Catalogue of Nautical Product |
| **abstract** | Catalogue of Nautical Product (CNP) is a vector dataset containing all relevant information regarding catalogue of nautical products like nautical chart and nautical publication within a defined geographical area. |
| **alternate title** | CNP |
| **content**  | Catalogue of Nautical Products information, such as coverage, producing agency, source indication and issue date that apply. |
| **geographicDescription** | **EX\_GeographicDescription:** E.g., official name of region |
| **spatialResolution** | MD\_Resolution>equivalentScale.denominator (integer) or MD\_Resolution>levelOfDetail (CharacterString). E.g.: “All scales” |
| **purpose** | Describing status of nautical products, and to allow the producer to exchange catalogue of nautical products with interested stakeholders |
| **language** | EN |

# Data Content and Structure

## Introduction

The S-128 product is based on the S-100 General Feature Model (GFM), and is a feature-based vector product. Figure 1 shows how the S-128 application schema is realized from the S-100 GFM. All S-128 features and information classes are derived from one of the abstract classes **FeatureType** and **InformationType** defined in the S-128 application schema, which realize the GFM meta-classes **S100\_GF\_FeatureType** and **S100\_GF\_InformationType** respectively.

CNPs are encoded as vector entities which conform to S-100 geometry configuration level 3b (S-100 section 7-5.3.5). S-128 further constrains Level 3a with the following:

* Coincident linear geometry must be avoided when there is a dependency between features.
* The interpolation of GM\_CurveSegment must be loxodromic.
* Linear geometry is defined by curves which are made of curve segments. Each curve segments contains the geographic coordinates as control points and defines an interpolation method between them. The distance between two consecutive control points must not exceed 0.3 mm at a display scale of 1:10000.

The following exception applies to S-128:

* The use of coordinates is restricted to two dimensions.
* Soundings features which use GM\_Point or GM\_Multipoint with three dimensional coordinates are not currently included in S-128.

This section contains the Application Schema expressed in UML and an associated Feature Catalogue. The Feature Catalogue is included in Annex X, and provides a full description of each feature type including its attributes, attribute values and relationships in the data product. Figure 6-1 shows an overview of the S-128 application schema.

The class comprising the S-128 application schema is the S-128 Domain model containing the features and information types that model the CNP application domain specifically. Geographic features in all three packages use the spatial types from S-100 Part 7, which are imported as-is into the S-128 spatial types package and can therefore can be used as types for S-128 spatial attributes. The spatial types package also contains definitions of ‘union types’ (combinations of the S-100 spatial types), since S-100 allows features to have different kinds of geometry but UML does not an attribute of a class to have multiple types. The S-128 application schema models spatial attributes as attributes of feature classes.



Figure 6-1. S-128 Data model overview

## Application Schema

The UML models shown below are the overall CNP application schema.

This section contains a general overview of the classes and relationships in the S-128 application schema. Detailed information about how to use the feature types and information types to encode CNP information is provided in the S-128 Data Classification and Encoding Guide.

The following conventions are used in the UML diagrams depicting the application schema:

* Standard UML conventions for classes, associations, inheritance, roles, and multiplicities apply. These conventions are described in Part 1 of S-100.
* *Italic* font for a class name indicates an abstract class.
* Feature classes are depicted with green background; the dark shade for abstract feature classes and the light shade for ordinary (non-abstract) feature classes.
* Information type classes are depicted with blue background; the dark shade for abstract information type classes and the light shade for ordinary information types.
* Association classes are depicted with a white background.
* Complex attributes are depicted with a pink background.
* Enumeration lists and codelists are depicted with a tan background. The numeric code corresponding to each listed value is shown to its right following an ‘=’ sign.
* No significance attaches to the color of associations.
* Where the association role or name is not explicitly shown, the default rules for roles and names apply:
	+ The role name is ‘the<CLASSNAME>’ where <CLASSNAME> is the name of the class to which that association end is linked.
	+ The association name is ‘<CLASSNAME1>\_<CLASSNAME2>’ where <CLASSNAME1> is the source and <CLASSNAME2> the target. In case of a feature/information association the feature is the source. For feature/feature or information/information associations without explicit names the source/target are indicated by an arrowhead.

The S-128 domain model consists of two classes which is feature type and information type.

The class for geographic features is feature type and the class for information types is information type.

CNP(Catalogue of Nautical Products) data products include Nautical products, Electronic chart and Paper chart. The geographic features included in the S-128 are:

* Electronic Chart: electronical chart products like S-57 ENC, S-101 ENC and digital chart for special purpose
* Paper Chart: nautical paper chart and special purpose chart published in paper
* Nautical Products: nautical publication, online service, S-100 compliant products and e-Navigation service, all navigational products except nautical charts.

The CNP data products have a CatalogueOfNauticalProduct feature type. Attributes like issueDate and editionNumber in CatalogueOfNauticalProduct are mandatory, but others are optional.

The abstract class CatalogueElements and AbstractChartProducts is an abstract class from which the geographic feature classes in the application schema are derived. CatalogueElements has common attributes for all nautical products. AbstractChartProducts has common attributes for chart typed products. The attributes defined in CatalogueElements are inherited by all S-128 geographic feature types. All the attributes in CatalogueElements area optional. A derived class may impose additional constraints, which will be described in the definition of the derived class or the S-129 DCEG.

Geographic features use spatial types defined in the geometry package for spatial attributes. Datasets comprised of S-128 features are described by metadata as defined in the S-128 metadata package. Metadata uses selected spatial types (specifically, it uses the polygon type to describe the coverage of a dataset).

ContactDetails is the only information type in the S-128 domain model. ContactDetails has attributes for contactInstructions, contactAddress, information, onlineResource, telecommunications and sourceIndication. All the attributes of ContactDetails are optional. A derived class may impose additional constraints, which will be described in the definition of the derived class or in the S-128 DCEG.



Figure 6-2. S-128 Application schema (Feature type, Information type)



Figure 6-3. S-128 Application schema (Complex Attribute type)



Figure 6-4. S-128 Application schema (Enumeration)

# Feature Catalogue

### Introduction

The Feature Catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in the product. The S-128 Feature Catalogue is available in an XML document which conforms to the S-100 XML Feature Catalogue Schema and can be downloaded from the IHO website (http://www.iho.int/). Simple attributes used in this specification are listed in Table 6.2 below.

**Name:** Catalogue of Nautical Products

**Scope:** Ocean, Coastal, Ports, Harbors and Inland waters

**Version Number:** 0.7.5

**Version Date:** 2019-11-20

**Producer:** International Hydrographic Bureau,
 4 quai Antoine 1er,
 B.P. 445
 MC 98011 MONACO CEDEX
 Telephone: +377 93 10 81 00
 Telefax: + 377 93 10 81 40

 URL http://www.iho.int

**Language:** English

## Feature Types

Feature types contain descriptive attributes that characterize real-world entities. The word ‘feature’ may be used in one of two senses – feature type and feature instance. A feature type is a class and is defined in a Feature Catalogue. A feature instance is a single occurrence of the feature type and represented as an object in a dataset. A feature instance is located by a relationship to one or more spatial instances. A feature instance may exist without referencing a spatial instance.

### Geographic

Geographic (Geo) feature types carries the descriptive characteristics of a real world entity.

### Meta

Meta features contain information about other features within a data set. Information defined by meta features override the default metadata values defined by the data set descriptive records. Meta attribution on individual features overrides attribution on meta features.

### Feature Relationship

A feature relationship links instances of one feature type with instances of the same or a different feature type.

### Information Types

Information types are identifiable pieces of information in a dataset that can be shared between other features. They have attributes but have no relationship to any geometry; information types may reference other information types.

### Attributes

S-128 defines attributes as either simple or complex.

#### Simple Attributes

S-128 uses ten types of simple attributes; they are listed in the following table:

|  |  |
| --- | --- |
| **Type** | **Definition** |
| Enumeration  | A fixed list of valid identifiers of named literal values |
| Boolean  | A value representing binary logic. The value can be either True or False. The default state for Boolean type attributes (i.e. where the attribute is not populated for the feature) is False. |
| Real  | A signed Real (floating point) number consisting of a mantissa and an exponent |
| Integer  | A signed integer number. The representation of an integer is encapsulation and usage dependent. |
| CharacterString  | An arbitrary-length sequence of characters including accents and special characters from a repertoire of one of the adopted character sets |
| Date  | A date provides values for year, month and day according to the Gregorian Calendar. Character encoding of a date is a string which must follow the calendar date format (complete representation, basic format) for date specified by ISO 8601:1988. EXAMPLE 19980918 (YYYY-MM-DD) |
| Time  | A time is given by an hour, minute and second. Character encoding of a time is a string that follows the local time (complete representation, basic format) format defined in ISO 8601:1988. EXAMPLE 183059 or 183059+0100 or 183059Z |
| Date and Time  | A DateTime is a combination of a date and a time type. Character encoding of a DateTime shall follow ISO 8601:1988 EXAMPLE 19850412T101530 |
| Codelist | A type of flexible enumeration. A code list type is a list of literals which may be extended only in conformance with specified rules. |
| Truncated date | One or more components of the Date type are omitted. |

Table 7-1 –Simple feature attributes.

#### Complex Attributes

Complex attributes are aggregations of other attributes that are either simple or complex. The aggregation is defined by means of attribute bindings.



Figure 7-1 - textContent – a complex attribute

## Units of Measure

The following units of measure is used in Marine Protected Areas datasets;

* Orientation is given in decimal degrees
* Radio frequency is given in hertz
* Uncertainty is given in meters

## Geometric Representation

Geometric representation is the digital description of the spatial component of an object as described in S-100 and ISO 19107. This product specification uses three types of geometries: GM\_Point, GM\_OrientableCurve, and GM\_OrientableSurface.



Figure 7-2. Geometric Primitives

# Coordinate Reference System (CRS)

### Introduction

The location of an object in the S-100 standard is defined by means of coordinates which relate a feature to a position. The coordinate reference system used for this product specification is World Geodetic System 1984 (WGS 84) which is defined by the European Petroleum Survey Group (EPSG) code 4326, (or similar - North American Datum 1983 / Canadian Spatial Reference System).

Spatial data are expressed as latitude (φ) and longitude (λ) geographic coordinates. Latitude values are stored as a negative number to represent a position south of the Equator. Longitude values are stored as a negative number to represent a position west of the Prime Meridian. Coordinates are expressed as real value, degree / degree decimal format. Datasets conforming to this product specification are not projected.

**Horizontal coordinate reference system:** WGS 84

**Projection:** None

**Vertical coordinate reference system:** Although all coordinates in a data set must refer to the same horizontal CRS different Vertical Datums can be used for the depth component of a coordinate tuple. Therefore the vertical CRS can be repeated. For each Vertical CRS a unique identifier is defined. Those identifiers will be used to indicate which Vertical CRS is used. Units must be in meters. (From S-101 Draft).

**Temporal reference system:** Gregorian calendar

**Coordinate reference system registry:** [EPSG Geodetic Parameter Registry](http://www.epsg-registry.org/)

**Date type (according to ISO 19115):** 002 - publication

### Horizontal reference system

Positional data is expressed in latitude and longitude geographic coordinates to one of the reference horizontal reference systems defined in the HORDAT attribute. Unless otherwise defined, the World Geodetic System 84 (WGS 84) will be used for CNP data products.

### Projection

CNP data products are un-projected.

### Vertical coordinate reference system

Although all coordinates in a data set must refer to the same horizontal CRS different Vertical Datums can be used for the depth component of a coordinate tuple. Therefore the vertical CRS can be repeated. For each Vertical CRS a unique identifier is defined. Those identifiers will be used to indicate which Vertical CRS is used. Units must be in meters.

### Temporal reference system

Time is measured by reference to Calendar dates and Clock time in accordance with ISO 19108:2002 Temporal Schema clause 5.4.4.

### Coverage of nautical products data and scale

CNP data must be compiled in the best applicable scale. The use of the data itself is "scale independent". That means that the data can be used at any scale. S-100 allows the association of multiple spatial attributes to a single feature instance. Each of thesespatial attributes can in principle be qualified by maximum and minimum scales.

For example, it is possible, within one dataset, to have a single instance of a feature that has more than one area geometry.Each of these geometries has different scale max/min attributes. Moreover, due to cluttering in smaller scales, the scale minimum attribute may be used to turn off portrayal of some features at smaller scales.

# Data Quality

## Introduction

Data quality allows users and user systems to assess fitness for use of the provided data. Data quality measures and the associated evaluation are reported as metadata of a data product. This metadata improves interoperability with other data products and provides usage by user groups that the data product was not originally intended for. The secondary users can make assessments of the data product usefulness in their application based on the reported data quality measures.

For S-128 the following data quality elements have been included:

* Conformance to this Product Specification;
* Intended purpose of the data product;
* Completeness of the data product in terms of coverage;
* Logical Consistency;
* Positional Uncertainty and Accuracy;
* Thematic Accuracy;
* Temporal Quality;
* Aggregation measures;
* Elements specifically required for the data product (none currently identified for S-128);
* Validation checks or conformance checks including:
	+ General tests for dataset integrity;
	+ Specific tests for a specific data model;

## Quality measure elements

The data quality measures recommended in S-97 (Part C) and their applicability in S-128 are indicated in Table 9.1 below. NA indicates the measure is not applicable. This table reproduces the first 4 columns of the data quality checklist recommended elements and replaces the final column with descriptions of the scope of the element in the context of S-128 datasets.

| No. | Data quality element and sub element | Definition | DQ measure / description | Evaluation scope | Scope in S-128 |
| --- | --- | --- | --- | --- | --- |
| 1 | Completeness / Commission | Excess data present in a dataset, as described by the scope. | numberOfExcessItems / This data quality measure indicates the number of items in the dataset, that should not have been present in the dataset. | dataset/dataset series | All features and info types |
| 2 | Completeness / Commission | Excess data present in a dataset, as described by the scope. | numberOfDuplicateFeatureInstances / This data quality measure indicates the total number of exact duplications of feature instances within the data. | dataset/dataset series | All features and info types |
| 3 | Completeness / Omission | Data absent from the dataset, as described by the scope. | numberOfMissingItems / This data quality measure is an indicator that shows that a specific item is missing in the data. | dataset/dataset series/spatial object type | All features and info types |
| 4 | Logical Consistency / Conceptual Consistency | Adherence to the rules of a conceptual schema. | numberOfInvalidSurfaceOverlaps / This data quality measure is a count of the total number of erroneous overlaps within the data. Which surfaces may overlap and which must not is application dependent. Not all overlapping surfaces are necessarily erroneous. | spatial object / spatial object type | Features with surface geometry; spatial objects of type surface |
| 5 | Logical Consistency / Domain Consistency | Adherence of the values to the value domains. | numberOfNonconformantItems / This data quality measure is a count of all items in the dataset that are not in conformance with their value domain. | spatial object / spatial object type | All features and info types |
| 6 | Logical Consistency / Format Consistency | Degree to which data is stored in accordance with the physical structure of the data set, as described by the scope | physicalStructureConflictsNumber / This data quality measure is a count of all items in the dataset that are stored in conflict with the physical structure of the dataset. | dataset/dataset series | All features and info types |
| 7 | Logical Consistency / Topological Consistency | Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope. | rateOfFaultyPointCurveConnections / This data quality measure indicates the number of faulty link-node connections in relation to the number of supposed link-node connections. This data quality measure gives the erroneous point-curve connections in relation to the total number of point-curve connections. | spatial object / spatial object type | Features with curve geometry; spatial objects of curve types |
| 8 | Logical Consistency / Topological Consistency | Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope. | numberOfMissingConnectionsUndershoots / This data quality measure is a count of items in the dataset within the parameter tolerance that are mismatched due to undershoots. | spatial object / spatial object type | Features with curve geometry; spatial objects of curve types |
| 9 | Logical Consistency / Topological Consistency | Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope. | numberOfMissingConnectionsOvershoots / This data quality measure is a count of items in the dataset within the parameter tolerance that are mismatched due to overshoots. | spatial object / spatial object type | Features with curve geometry; spatial objects of curve types |
| 10 | Logical Consistency / Topological Consistency | Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope. | numberOfInvalidSlivers / This data quality measure is a count of all items in the dataset that are invalid sliver surfaces. A sliver is an unintended area that occurs when adjacent surfaces are not digitized properly. The borders of the adjacent surfaces may unintentionally gap or overlap to cause a topological error. | dataset / dataset series | Features with surface geometry; spatial objects of type surface |
| 11 | Logical Consistency / Topological Consistency | Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope. | numberOfInvalidSelfIntersects / This data quality measure is a count of all items in the dataset that illegally intersect with themselves. | spatial object / spatial object type | Features with surface geometry; spatial objects of type surface or curve |
| 12 | Logical Consistency / Topological Consistency | Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope. | numberOfInvalidSelfOverlap / This data quality measure is a count of all items in the dataset that illegally self-overlap. | spatial object / spatial object type | Features with surface geometry; spatial objects of type surface or curve |
| 13 | Positional Accuracy / Absolute or External Accuracy | Closeness of reported coordinative values to values accepted as or being true. | Root Mean Square Error / Standard deviation, where the true value is not estimated from the observations but known a priori. | spatial object / spatial object type | objects that have coordinative values associated. |
| 14 | Positional Accuracy / Vertical Position Accuracy | Closeness of reported coordinative values to values accepted as or being true. | linearMapAccuracy2Sigma / Half length of the interval defined by an upper and lower limit in which the true value lies with probability 95%. | spatial object / spatial object type | NA. S-128 does not include vertical measurements. |
| 15 | Positional Accuracy / Horizontal Position Accuracy | Closeness of reported coordinative values to values accepted as or being true. | linearMapAccuracy2Sigma / Half length of the interval defined by an upper and lower limit in which the true value lies with probability 95%. | spatial object / spatial object type | objects that have a horizontal coordinate values associated. |
| 16 | Positional Accuracy / Gridded Data Position Accuracy | Closeness of reported coordinative values to values accepted as or being true. | Root mean square error of planimetry / Radius of a circle around the given point, in which the true value lies with probability P. | spatial object / spatial object type | NA. S-128 does not have features with gridded geometry |
| 17 | Temporal Quality / Temporal Consistency | Consistency with time. | Correctness of ordered events or sequences, if reported. | dataset/dataset series/spatial object type | Features with time intervals, fixed/periodic date ranges, schedules. |
| 18 | Thematic Accuracy / ThematicClassificationCorrectness | Comparison of the classes assigned to features or their attributes to a universe of discourse. | miscalculationRate / This data quality measure indicates the number of incorrectly classified features in relation to the number of features that are supposed to be there. [Adapted from ISO 19157] This is a RATE which is a ratio, and is expressed as a REAL number representing the rational fraction corresponding to the numerator and denominator of the ratio. For example, if there are 1 items that are classified incorrectly and there are 100 of the items in the dataset then the ratio is 1/100 and the reported rate = 0.01. | dataset/dataset series/spatial object type | All features and info types |
| 19 | Aggregation Measures / AggregationMeasures | In a data product specification, several requirements are set up for a product to conform to the specification. | DataProductSpecificationPassed / This data quality measure is a boolean indicating that all requirements in the referred data product specification are fulfilled. | dataset/dataset series/spatial object type | Dataset as a whole |
| 20 | Aggregation Measures / AggregationMeasures | In a data product specification, several requirements are set up for a product to conform to the specification. | DataProductSpecificationFailRate / This data quality measure is a number indicating the number of data product specification requirements that are not fulfilled by the current product/dataset in relation to the total number of data product specification requirements. | dataset/dataset series/spatial object type | Dataset as a whole |

Table 9.1 - IHO recommended quality elements and their relevance to S-128

## Test methods

Test methods consist of executing the relevant tests from Annex E (Validation Checks) for each quality element in Table 9.1 and counting the number of instances in the dataset which fail the checks for that quality element.

Note that in some cases “executing the relevant test” may involve comparing the encoded S-128 dataset to the source material by visual means (e.g., for measures 17 and 18). For tests requiring visual comparison of encoded data to source material, sampling methods may be used if the volume of data precludes checking all the relevant data objects.

### Accuracy computations

Recommendations for Positional Accuracy / Absolute or External Accuracy:

Maximum RMSE (horizontal) = E / 10000

Where:

E = Denominator of intended scale of mapping

## Data quality testing and reporting

S-128 products must be tested with the S-128 specific checks prior to release by the data producer. The data producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are a mix of data format validation checks, conformance to standard checks and logical consistency checks. The checks are listed in Annex E.

Production and certification processes for S-128 data should include a standalone quality report which provides full information on the original results (with evaluation procedures and measures applied).

The dataset or exchange set metadata that is distributed with the exchange set may describe only the aggregated result with a reference to the original results described in the standalone quality report. The aggregated Data Quality result provides an indication if the dataset has passed conformance to the Data Product Specification.

Data Quality Measure Aggregation results should be included to indicate if the dataset/dataset series have passed the Product Specifications. The elements which must be included are described in Table 9.2.

| Data quality element and sub element | Definition | DQ measure / description | Evaluation scope | Applicable to spatial representation types |
| --- | --- | --- | --- | --- |
| Aggregation Measures / AggregationMeasures | In a data product specification, several requirements are set up for a product to conform to the specification. | DataProductSpecificationPassed / This data quality measure is a boolean indicating that all requirements in the referred data product specification are fulfilled. | dataset | All features and information types of the dataset |
| Aggregation Measures / AggregationMeasures | In a data product specification, several requirements are set up for a product to conform to the specification. | DataProductSpecificationFailRate / This data quality measure is a number indicating the number of data product specification requirements that are not fulfilled by the current product/dataset in relation to the total number of data product specification requirements. | dataset | All features and information types of the dataset |

Table 9.2 - Elements of data quality aggregated report (extract from S-97 Part C checklist)

# Data Capture and Classification

S-128 products must be based on data sources released by an appropriate CNP defining authority. Data source must be described in each data product.

The production process used to generate CNP products may be described in the dataset metadata.

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Name**  | **Description**  | **Multiplicity**  | **Type** |
| dataSource | Identification of the kinds of data sourcesusable to product datasets compliant with theconsidering specification | 0..\* | CharacterString |
| productionProcess | Link to a textual description of the productionprocess (including encoding guide)applicable to the datasets compliant with theconsidering specification | 0..\* | CharacterString (URL) |

Table 10-1. Data capture information

## Data Encoding and Product Delivery

### Data Encoding

The principal encoding will be the Open Geospatial Consortium (OGC), Geography Markup Language (GML) format. GML is an XML grammar designed to express geographical features. It serves as a modelling language for geographic systems as well as an open interchange format for geographic transactions.

### Types of Datasets

A dataset is a grouping of features, attributes, geometry and metadata which comprises a specific coverage. The following types of CNP dataset may be produced and contained within an exchange set:

|  |  |
| --- | --- |
| Dataset | Explanations |
| New dataset (base dataset): | Data for an area different (in coverage and/or extent) to existing datasets. |
| New Edition of a dataset: | A re-issue plus new information which has not been previously distributed by Updates. Each New Edition of a dataset must have the same name as the dataset that it replaces and should have the same spatial extents. The edition number in the dataset discovery metadata shall increment up by one from the previous edition. |
| Update dataset | A delta change of the latest edition of a dataset. If there are more than one update dataset, the subsequent update will be a delta of the base dataset + earlier update datasets. |
| Cancellation | Used to cancel dataset and any related update datasets. |

Table 10.2 CNP dataset types

### Content of Update Datasets

Update datasets can only contain replacements, deletions and additions of whole feature instances or information instances. This means that when a feature or information instance is updated, the new version must contain all the attributes of the old instance, including any inline spatial attributes (i.e., inline geometry), except those attributes that are being removed.

An association to an instance of a feature or information type is treated as an attribute of the referring instance, and therefore adding or deleting an association means the original referring instance must be replaced with a new version. The instance at the other end of the association needs to be replaced if and only if it contains a reference to the first instance.

Spatial objects that are not inline (i.e., geometry that is encoded as an independent spatial object in the dataset) is treated like any other object, i.e., it needs to be updated if and only if the primitive has changed (e.g., a coordinate is updated).

Feature and information type instances are deleted without replacement by setting the fixedDateRange.dateEnd attribute of the instance to the date of deletion, which will usually be the issue date of the update.

## Encoding of Latitude and Longitude

Values of latitude and longitude must be accurate to 7 decimal places. Coordinates must be encoded as decimals in the format described below. The encoding is indicated by multiplication factor fields defined in the dataset identification record.

### Encoding of coordinates as decimals

Values should be coded as decimal numbers with 7 or fewer digits after the decimal. The normative encoding is in degrees, with an accuracy of 10-7 degrees, i.e., 7 digits after the decimal point.

The decimal point must be indicated by the “.” character.

Trailing zeroes after the decimal point (and the decimal point itself if appropriate) may be omitted at producer discretion, but the accuracy must still be as indicated (e.g., 10-7 degrees for coordinates of default accuracy).

Latitude and longitude multiplication factors held in the Dataset Structure Information field under [coordMultFactorX] and [coordMultFactorY] must be set to a value corresponding to the encoding, i.e., {1} for coordinates encoded in decimal degrees.

EXAMPLE 1 A longitude = 42.0000 is converted into X = longitude \* coordMultFactorX = 42.0000 \* 1 = 42.0000000.

## Numeric Attribute Encoding

Floating point and integer attribute values must not contain leading zeros. Floating point attribute values must not contain non-significant trailing zeros.

## Text Attribute Values

Character strings must be encoded using the character set defined in ISO 10646-1, in Unicode Transformation Format-8 (UTF-8).

## Mandatory Attribute Values

There are four reasons why attribute values may be considered mandatory:

* They determine whether a feature is in the display base,
* Certain features make no logical sense without specific attributes,
* Some attributes are necessary to determine which symbol is to be displayed,
* Some attributes are required for safety of navigation.

All mandatory attributes are identified in the Feature Catalogue and summarised in Annex A – Data Classification and Encoding Guide.

## Unknown Attribute Values

When a mandatory attribute code or tag is present but the attribute value is missing, it means that the producer wishes to indicate that this attribute value is unknown. Missing mandatory attributes must be “nilled”.

Optional attributes must be omitted altogether if the value is unknown or missing. They must not be “nilled.”

EXAMPLE A landmark feature has unknown category of landmark (mandatory attribute) and function (optional attribute). The feature could be coded as:

<Landmark>

 <categoryOfLandmark xsi:nil="true"/>

 <function>radio</function>

 … other attributes…

 … <status> is NOT coded …

<Landmark>

## Structure of dataset files

### Sequence of objects

The order of data objects in each dataset file is described below:

Dataset Identification Information

Dataset structure information

Spatial records for by-reference geometries

 Point

 Multi point

 Curve

 Composite Curve

 Surface

Information objects

Feature objects (Geometry may be encoded inline or by reference.)

Meta features

Geo features

## Object identifiers

The “name” of feature records must provide a unique world-wide identifier of feature records. The “name” of the record is the combination of the subfields **agency**, **featureObjectIdentifier**, and **featureIdentificationSubdivision** elements of the **featureObjectIdentifier** element of the object.

Features, information types, collection objects, meta features, and geometries (inline or external) are all required by the schema to have a **gml:id** attribute with a value that is unique within the dataset. The **gml:id** values must be used as the reference for the object from another object in the same dataset or another dataset.

## Data coverage

All areas of a dataset must be covered by a **DataCoverage** meta feature.

An update dataset must not change the limit of a **Data Coverage** feature for the base dataset. Where the limit of a **Data Coverage** feature for a base dataset is to be changed, this must be done by issuing a new edition of the dataset.

##  Data overlap

S-128 datasets can overlap other S-128 datasets.

## Data extent

Datasets must not cross the 180° meridian of longitude

# Data Delivery

## Data Product Delivery Information

This data product specification defines GML as the primary format in which CNP data products are delivered. The delivery format is described by the following items (from ISO 19131:2005): format name, version, specification, language, character set.

|  |  |  |
| --- | --- | --- |
| **Name** | **ISO 19131 Elements** | **Value** |
| Format name | DPS\_DeliveryInformation.deliveryFormat > DPS\_DeliveryFormat.formatName | GML\* |
| Version | DPS\_DeliveryInformation.deliveryFormat > DPS\_DeliveryFormat.version | 3.2.1 |
| Specification description | DPS\_DeliveryInformation.deliveryFormat > DPS\_DeliveryFormat.specification | GML\*  |
| Language | DPS\_DeliveryInformation.deliveryFormat > DPS\_DeliveryFormat.language | English |
| Character set | DPS\_DeliveryInformation.deliveryFormat > DPS\_DeliveryFormat.characterSet > MD\_CharacterSetCode | 004 – utf8 |

Table 11.1 Data product delivery

\* GML is an XML encoding for the transport and storage of geographic information, including both the geometry and the properties of geographic features, between distributed systems. The XML Schema for the GML application schema is provided in a schema document S128.xsd which imports other schema(s) defining common types. (All files are available on the S-100 distribution site https://github.com/IHO-S100WG ). Feature instance shall validate against S128.xsd and conform to all other requirements specified in this data product specification including all constraints not captured in the XML Schema document.

### Dataset loading

Datasets must always be loaded in the order of base dataset first, then update datasets in the corrected sequential order. Systems are not to load updates out of order, for example if update 1-5 is present, then 6 is missing, update 7 must not be loaded.

### New editions

When a new edition of a dataset is received, the system must replace the previous edition, along with any updates with the new edition of the dataset. Loading of subsequent updates follow the same rule as above.

## Dataset size

CNP datasets shall not exceed 20MB.

Update datasets shall not exceed 500KB.

## Exchange Set

Data which conforms to this product specification must be delivered by means of an exchange set.

An exchange set will consist of one or more CNP datasets. An exchange set may also include one or more support files containing supplementary information encoded in separate files. These are linked to the CNP dataset features, using the attributes described below. Each exchange set will include a single (XML) catalogue file, S-128 exchange set catalogues conform to S-100 3.0.0 Figure 4a-D-2 without modification, containing discovery metadata for each CNP dataset as well as support files. S-128 Exchange set structure conforms to S-100 3.0.0 Figure 4a-D-3 without modification.



Figure 11-1. Exchange set structure

## Support Files

Support files contain ancillary textual or graphic information in separate (linked to the dataset) files. The following formats are allowed for support files:

* Plain text files must contain only general text as defined in this standard. Files must use the UTF-8 character set encoding.
* HTML and XML files must contain only text and markup as defined in the relevant W3C standards. Files must use the UTF-8 character set encoding. References in datasets to HTML and XML support files must treat them as text files (i.e., they should not be referenced using attributes intended for picture files).
* Picture files must be in the Tagged Image file Format (TIFF) [Edition 6.0].

Table 11.2 describes the constraints on support file formats and provides the corresponding file extensions.

|  |  |  |
| --- | --- | --- |
| **File type** | **Extension** | **Description** |
| Text | TXT |  |
| HTM | HTML files must only include inline or embedded Cascading Style Sheet (CSS) information and must not contain embedded Javascript or other dynamic content, for example DHTML, Flash etc. |
| XML | XML documents must only be included in accordance with guidance provided within the Data Classification and Encoding Guide (Annex A) and must not contain embedded Javascript or other dynamic content. |
| Picture | TIF | Baseline TIFF 6.0. |

Table 11.2 Support file formats and extensions

## Support File Naming Convention

All support files will have unique world-wide file identifiers. The file identifier of support information should not be used to describe the physical content of the file. The support file metadata that accompanies the file will inform the user of the name and purpose of the file (new, replacement and deletion).

In this encoding the support files are named according to the specifications given below:

128CCCCXXXXXXXX.YYY

The main part forms an identifier where:

* The first three characters are always “128” and identify the dataset as an S-128 dataset.
* The next four characters identify the issuing agency by its alphanumeric agency code in the IHO producer code register in the IHO GI Registry (i.e., the IHO is identified as “AA”, not “1810”). Where the agency code consists of fewer than four characters, sufficient zeros must be suffixed to make the length exactly four characters (e.g., “AA00” for IHO).
* The eighth up to the fifteenth character can be used in any way by the producer to provide a unique file name for the dataset. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character \_ (underscore). The ninth through fifteenth characters are optional (i.e., at least one character must be used).
* .YYY – support file extension. The YYY portion must conform to the file format as described in Table 11.2.

## Dataset Naming Convention

All dataset files will have unique world-wide file identifiers. The file identifier of the dataset should not be used to describe the physical content of the file. The dataset file metadata that accompanies the file will inform the user of the name and purpose of the file (new, replacement, and deletion).

In this encoding the dataset files are named according to the specifications given below:

128CCCCXXXXXXXXXX.GML

The main part forms an identifier where:

* The first three characters are always “128” and identify the dataset as an S-128 dataset.
* The next four characters identify the issuing agency by its alphanumeric agency code in the IHO producer code register in the IHO GI Registry (i.e., the IHO is identified as “AA”, not “1810”). Where the agency code consists of fewer than four characters, sufficient zeros must be suffixed to make the length exactly four characters (e.g., “AA00” for IHO).
* The eighth up to the seventeenth character can be used in any way by the producer to provide a unique file name for the dataset. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character \_ (underscore). The ninth through seventeenth characters are optional (i.e., at least one character must be used).

## Update dataset naming convention

All update dataset files will have an identical name to the base dataset, aside from the separator and update number sequence.

In this encoding the update dataset files are named according to the specifications given below:

128CCCCXXXXXXXXXX\_XXX.GML

The main part forms an identifier where:

* The first up to the seventeenth characters are the same as the dataset being updated and therefore conform to the rules described in clause 11.6.
* The next character must be an underscore “\_”.
* The next three characters must be numerical (0-9) characters to indicate the place of the update dataset in the update sequence.

## Catalogue File Naming Convention

The exchange catalogue acts as the table of contents for the exchange set. The catalogue file of the exchange set must be named CATALOG.XML. No other file in the exchange set may be named CATALOG.XML. The content of the exchange catalogue file is described in Clause 14.

# Dataset Maintenance

## Introduction

Datasets are maintained as needed and must include mechanisms for CNP updating. Data updates will be made by new editions. The maintenance and update frequency of CNP datasets should be defined by the producers (official national authority) implementing this specification.

Data Producers must use applicable sources to maintain and update data and provide a brief description of the sources that were used to produce the dataset in the appropriate metadata field.

Data Producers must use applicable sources to maintain and update data and provide a brief description of the sources that were used to produce the dataset in the appropriate metadata field.

## Production process for base and update datasets

Data Producers should follow their established production processes for maintaining and updating datasets. Data is produced against the DCEG and checked against the appropriate set of validation rules in Appendix X.

## Dataset updates and cancellation

The purpose of issue of the dataset is indicated in the “purpose” field of the dataset discovery metadata. In order to terminate a dataset, an update dataset file is created for which the edition number must be set to 0. This convention is only used to cancel a base dataset file.

Where a dataset is cancelled and its name is reused at a later date, the issue date must be greater than the issue date of the cancelled dataset.

When the dataset is cancelled, it must be removed from the system.

An exchange set may contain base dataset files and update dataset files for the same datasets. Under these circumstances the update dataset files must follow in the correct sequential order from the last update applied to the base dataset file.

## Support file updates

The purpose of issue is indicated in the “purpose” field of the support file discovery metadata. Support files carrying the “deletion” flag in metadata must be removed from the system. When a feature or information type pointing to a text, picture or application file is deleted or updated so that it no longer references the file, the system software must check to see whether any other feature or information type references the same file, before that file is deleted.

Updates or deletions of a support file may require concurrent updates to feature or information type instance attributes that depend on the file, e.g., pictorialRepresentation, fileReference and fileLocator attributes.

## Feature and portrayal catalogues

For each new version of the S-128 Product Specification a new feature and portrayal catalogue will be released. The system must be able to manage datasets and their catalogues that are created on different versions of the S-128 product specification.

## Feature history, versions, and change tracking

If applications or production systems require versioning of individual instances of feature or information types, maintenance of histories, or change tracking, the methods for versioning, history management, and change tracking and display are left to the application or production system.

## Dataset encryption

Details about dataset encryption are still to be determined, and may mirror the method described in S-101.

# Portrayal

Portrayal is not defined in this version of S-128 Catalogue of Nautical Products Specifications. Users are free to choose the means and methodology of portrayal as they see best suited for their needs. It should be noted that future versions of S-128 may include a portray catalogue, and any implementer should therefore anticipate this, and make sufficient provisions in any system supporting S-128.

# Metadata

## Introduction

The CNP metadata specification conforms to the S-100 metadata specification in Part 4a, which is a profile of the ISO 19115-1 standard. These documents provide a structure for describing digital geographic data and define metadata elements, a common set of metadata terminology, definitions, and extension procedures.

The overall structure of metadata in S-128 exchange sets is the same as in S-100, and is depicted in Figure 31. Metadata in exchange sets consists of discovery metadata for the datasets and support files in the exchange set (classes S100\_DatasetDiscoveryMetadata and S100\_SupportFileDiscoveryMetadata), metadata in ISO 19115-1 format for datasets, and metadata about any feature, portrayal, or interoperability catalogues which are in the exchange set (S100\_CatalogueMetadata).

The discovery metadata classes have numerous attributes which enable important information about the datasets and accompanying support files to be examined without the need to process the data, for example decrypt, decompress, load etc. Other catalogues such as feature and portrayal catalogues can be included in the exchange set in support of the datasets.

More detailed information for the classes is depicted in Figure 32 and details about the metadata classes are provided in clauses 14.2–14.5.



Figure 14-1 –Metadata in exchange catalogue



Figure 14-2. S-128 Exchange catalogue and discovery metadata

NOTE 1: Types with CI\_, EX\_, and MD\_ prefixes are from packages defined in ISO 19115-1 and 19115-3 and adapted by S-100. Types with S100\_ prefix are from packages defined in S-100.

NOTE 2: When a dataset is terminated, the purpose metadata field is set to 3 (terminated), and the editionNumber metadata field is set to 0. All inapplicable but mandatory metadata fields must be nilled.

In Figure 14-2 and the following clauses, classes show only those attributes which are used in S-128 exchange catalogues. Similarly, enumerations show only those values which are allowed in S-128 exchange catalogues.

## Dataset Metadata

Dataset metadata is intended to describe information about a dataset. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of a dataset. Whereas dataset metadata is usually fairly comprehensive, there is also a requirement for a constrained subset of metadata elements that are usually required for discovery purposes. Discovery metadata are often used for building web catalogues, and can help users determine whether a product or service is fit for purpose and where they can be obtained.

### Metadata for new datasets and new editions

Dataset discovery metadata for new datasets and new editions of published datasets is described in Table 14.1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Multiplicity** | **Value** | **Type** | **Remarks** |
| S100\_DataSetDiscoveryMetadata |  |  | Class | The following S-100 attributes are not used: verticalDatum, soundingDatum, optimumDisplayScale, maximumDisplayScale, minimumDisplayScale. |
| fileName  | 1 |  | CharacterString  | Dataset file name (see 11.6) |
| filePath  | 1 |  | CharacterString  | Full path from the exchange set root directory  |
| description  | 1 |  | CharacterString  | Short description of the area covered by dataset, e.g., area, harbour, or port name, between two named locations etc. |
| dataProtection  | 0..1 |  | Boolean  | TRUE: EncryptedFALSE: Unencrypted |
| protectionScheme  | 0..1 |  | S100\_ProtectionScheme | See Figure 32 and S-100 Appendix 4a-D. |
| digitalSignatureReference | 1 |  | S100\_DigitalSignature | Specifies the algorithm used to compute digitalSignatureValue.See Figure 32 and S-100 Appendix 4a-D. |
| digitalSignatureValue | 1 |  | S100\_DigitalSignatureValue | The value resulting from application of digitalSignatureReference.Implemented as the digital signature format specified in S-100 Part 15. |
| copyright | 0..1 |  | MD\_LegalConstraints>MD\_RestrictionCode<copyright> (ISO 19115-1) | “copyright” for copyrighted datasets, omitted otherwise |
| classification | 0..1 | (one of the literals from the ISO codelist) | ClassMD\_SecurityConstraints>MD\_ClassificationCode (codelist)ISO 19115-1 | 1. unclassified2. restricted3. confidential4. secret5. top secret6. sensitive but unclassified7. for official use only8. protected9. limited distribution |
| purpose  | 1 | {1}, {2} | MD\_Identification>purpose (character string) | 1. New dataset
2. New edition
 |
| specificUsage  | 1 |  | MD\_USAGE>specificUsage(character string)MD\_USAGE>userContactInfo(CI\_Responsibility) | brief description of the resource and/or resource series usage |
| editionNumber  | 1 |  | CharacterString  | When a dataset is initially created, the edition number “1” is assigned to it. The edition number is increased by one with each new edition.  |
| issueDate  | 1 |  | Date  | Date on which the dataset was generated.  |
| issueTime | 0..1 |  | Time | Encoded only if time of issue is significant. |
| productSpecification  | 1 |  | S100\_ProductSpecification | See Notes below this table for constraints on values. |
| producingAgency  | 1 |  | CI\_Responsibility>CI\_Organisation orCI\_Responsibility>CI\_Individual | Party responsible for generating the dataset.See Part 4a Tables 4a-2 and 4a-3.  |
| horizontalDatumReference | 1 | EPSG  | CharacterString |  |
| horizontalDatumValue  | 1 | 4326 | Integer  | WGS84 |
| epoch | 0..1 |  | CharacterString | For example, G1762 for the 2013-10-16 realization of the geodetic datum for WGS84 |
| dataType  | 1 | GML  | S100\_DataFormat | The only value allowed is “GML”. |
| dataTypeVersion | 1 | 3.2.1 | CharacterString |  |
| dataCoverage | 1..\* |  | S100\_DataCoverage | See Figure 32 and S-100 Appendix 4a-D. A new or new-edition S-128 dataset must have at least one coverage. |
| comment  | 0..1 |  | CharacterString  | Any additional Information  |
| layerID | 1..\* | S-101 | CharacterString | Dataset must be used with ENC in an ECDIS.Mandatory for S-128 new datasets and new editions. |
| defaultLocale | 1 |  | PT\_Locale | See Figure 32 and S-100 Appendix 4a-D. |
| otherLocale | 0..\* |  | PT\_Locale | See Figure 32 and S-100 Appendix 4a-D. |
| metadataFileIdentifier | 1 |  | CharacterString | For example, identifier for ISO 19115-3 metadata file |
| metadataPointOfContact | 1 |  | CI\_Responsibility>CI\_Individual orCI\_Responsibility>CI\_Organisation | See S-100 Part 4a Tables 4a-2 and 4a-3. |
| metadataDateStamp | 1 |  | Date | Metadata creation date, which may or may not be the dataset creation date |
| metadataLanguage | 1..\* |  | CharacterString |  |
| -- | 0..\* |  | Aggregation S100\_SupportFileDiscoveryMetadata | One for each support file linked to this dataset and present in the exchange set. |

Table 14.1 Dataset discovery metadata

NOTES:

1. Attribute *productSpecification*: The values of sub-attributes *name* and *version* must correspond to this version of the S-128 product specification. (Clause 4.2). The value of sub-attribute *number* must be the number assigned to this version of the S-128 product specification in the GI registry.

### Update and Cancellation Dataset Metadata

Update dataset metadata (Table 14.2) is intended to describe information about an update dataset. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of an update dataset. Whereas dataset metadata is usually fairly comprehensive, metadata for update datasets only describe the issue date and sequential relation to the base dataset.

Update dataset discovery metadata omits the dataCoverage, specificUsage and layerID metadata attributes.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name**  | **Multiplicity** | **Value**  | **Type**  | **Remarks** |
| S100\_DataSetDiscoveryMetadata |  |  | Class | The following S-100 attributes are not used for update datasets: verticalDatum, soundingDatum, optimumDisplayScale, maximumDisplayScale, minimumDisplayScale, dataCoverage, specificUsage, layerID. |
| fileName  | 1 |  | CharacterString  | Dataset file name (see 11.7) |
| filePath  | 1 |  | CharacterString  | Full path from the exchange set root directory  |
| description  | 1 |  | CharacterString  | Brief description of the update. |
| dataProtection  | 0..1 |  | Boolean | Value must be same as base dataset. |
| protectionScheme  | 0..1 |  | S100\_ProtectionScheme | Value must be same as base dataset. |
| digitalSignatureReference | 1 |  | S100\_DigitalSignature | Specifies the algorithm used tocompute digitalSignatureValue.See Figure 32 and S-100 Appendix 4a-D. |
| digitalSignatureValue | 1 |  | S100\_DigitalSignatureValue | The value resulting from application of digitalSignatureReference.Implemented as the digital signature format specified in S-100 Part 15. |
| copyright | 0..1 |  | MD\_LegalConstraints>MD\_RestrictionCode<copyright> (ISO 19115-1) | Value must be same as base dataset. |
| classification | 0..1 | (one of the literals from the ISO codelist) | ClassMD\_SecurityConstraints>MD\_ClassificationCode (codelist) | Value must be same as base dataset. |
| purpose | 1 | {3}, {4}  | CharacterString | 1. Update
2. Cancellation
 |
| editionNumber  | 1 |  | CharacterString | Value must be same as base dataset. |
| updateNumber | 1 |  | CharacterString | Update sequence number, must match file name. |
| updateApplicationDate | 1 |  | Date | Date of update |
| issueDate  | 1 |  | Date  | Date on which the dataset was generated.  |
| issueTime | 0..1 |  | Time | Encoded only if time of issue is significant such as when more than one update is planned in a day. |
| productSpecification  | 1 |  | S100\_ProductSpecification | Value must be same as base dataset. |
| producingAgency  | 1 |  | CI\_Responsibility>CI\_Organisation orCI\_Responsibility>CI\_Individual | Party responsible for generating the dataset.See Part 4a Tables 4a-2 and 4a-3.  |
| horizontalDatumReference | 1 | EPSG | CharacterString |  |
| horizontalDatumValue  | 1 | 4326  | Integer  | WGS84  |
| epoch | 0..1 |  | CharacterString | Must be same as base dataset |
| dataType  | 1 | GML  | CharacterString |  |
| dataTypeVersion | 1 | 3.2.1 | CharacterString |  |
| comment  | 0..1 |  | CharacterString  | Any additional Information  |
| defaultLocale | 1 |  | PT\_Locale | Must be same as base dataset.See Figure 32 and S-100 Appendix 4a-D. |
| otherLocale | 0..\* |  | PT\_Locale | Must be same as base dataset.See Figure 32 and S-100 Appendix 4a-D. |
| metadataFileIdentifier | 1 |  | CharacterString | For example, for ISO 19115-3 metadata file |
| metadataPointOfContact | 1 |  | CI\_Responsibility>CI\_Individual orCI\_Responsibility>CI\_Organisation | See S-100 Part 4a Tables 4a-2 and 4a-3. |
| metadataDateStamp | 1 |  | Date | Metadata creation date, which may or may not be the dataset creation date |
| metadataLanguage | 1..\* |  | CharacterString | Must be same as base dataset |
| -- | 0..\* |  | Aggregation S100\_SupportFileDiscoveryMetadata | One for each support file that is referenced by the update dataset and present in the exchange set. |

Table 14.2 Update dataset metadata

## Support file Metadata

Support file metadata (Table 14.3) is intended to describe information about a data resource. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of a data resource.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name**  | **Multiplicity** | **Value**  | **Type**  | **Remarks**  |
| S100\_SupportFileDiscoveryMetadata |  |  | Class |  |
| fileName | 1 |  | CharacterString |  |
| fileLocation | 1 |  | CharacterString | Path relative to the root directory of the exchange set. The location of the file after the exchange set is unpacked into directory <EXCH\_ROOT> will be<EXCH\_ROOT>/<filePath>/<filename> |
| purpose | 1 |  | S100\_SupportFilePurpose | new, replacement, or deletion.Values "replacement” and “deletion” are allowed only in update datasets. |
| editionNumber | 1 |  | CharacterString  | When a dataset is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition. Edition number remains the same for a re-issue |
| issueDate | 1 |  | Date  |  |
| supportFileSpecification | 1 |  | S100\_SupportFileSpecification | See Figure 32 and S-100 Appendix 4a-D. |
| dataType | 1 |  | S100\_SupportFileFormat | The only values allowed for support files referenced in datasets are: ASCII (for text files), TIFF, and HTML.Values XML, XSLT, and LUA are reserved for portrayal catalogue files. |
| otherDataTypeDescription | 0..1 |  | CharacterString |  |
| comment | 0..1 |  | CharacterString |  |
| digitalSignatureReference | 0..1 |  | S100\_DigitalSignature | Specifies the algorithm used to compute digitalSignatureValue.See Figure 32 and S-100 Appendix 4a-D. |
| digitalSignatureValue | 0..1 |  | S100\_DigitalSignatureValue | The value resulting from application of digitalSignatureReference.Implemented as the digital signature format specified in S-100 Part 15. |
| defaultLocale | 1 |  | PT\_Locale | See Figure 32 and S-100 Appendix 4a-D. |
| otherLocale | 0..\* |  | PT\_Locale | See Figure 32 and S-100 Appendix 4a-D. |

Table 14.3 Support file metadata

## Exchange set catalogue and metadata

Frequently datasets are packaged and distributed as composite exchange sets by third party vendors. An exchange set could contain many different types of datasets, sourced from different data producers. For example an exchange set may contain numerous dataset files, ancillary data files, discovery metadata files and others. Exchange set metadata contains metadata about the contents of the exchange set and metadata about the data distributor.

### Catalogue File Metadata.

All S-128 Catalogue metadata files must contain at least the following metadata elements.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name**  | **Multiplicity** | **Value**  | **Type**  | **Remarks**  |
| S100\_ExchangeCatalogue |  |  | Class |  |
| identifier | 1 |  | S100\_CatalogueIdentifier | See Notes below this table. |
| contact | 1 |  | S100\_CataloguePointOfContact | No special constraints on the S-100 class. |
| productSpecification | 0..1 |  | S100\_ProductSpecification | Conditional on all the datasets using the same product specification. See note below this table for constraints on values. |
| metadataLanguage  | 1 | English | CharacterString  | All datasets conforming to this PS must use English language. A catalogue in English must be provided. Discovery metadata elements within catalogues have their own locale attributes and may be repeated in languages other than English. |
| exchangeCatalogueName | 1 | CATALOG.XML | CharacterString  | Catalogue filename  |
| exchangeCatalogueDescription | 1 |  | CharacterString |  |
| exchangeCatalogueComment | 0..1 |  | CharacterString | Any additional Information |
| compressionFlag | 0..1 |  | Boolean | TRUE: compressedFALSE: not compressedIf compressed, the method must be that specified in S-100 Part 15. |
| sourceMedia | 0..1 |  | CharacterString |  |
| replacedData | 0..1 |  | Boolean |  |
| dataReplacement | 0..1 |  | CharacterString |  |
| datasetDiscoveryMetadata | 0..\* |  | Aggregation S100\_DatasetDiscoveryMetadata |  |
| -- | 0..\* |  | Aggregation S100\_CatalogueMetadata | Metadata for the feature, portrayal, and interoperability catalogues, if any |
| supportFileDiscoveryMetadata | 0..\* |  | Aggregation S100\_SupportFileDiscoveryMetadata |  |

Table 14.4 S100\_ExchangeCatalogue

NOTES:

1. Attribute *productSpecification*: Class **S100\_ProductSpecification** is depicted in Figure 32 and defined in S-100 Appendix 4a-D. The values of sub-attributes *name* and *version* must correspond to this version of the S-128 product specification. (Clause 4.2). The value of sub-attribute *number* must be the number assigned to this version of the S-128 product specification in the GI registry.
2. Attribute *catalogueIdentifier*: Class **S100\_CatalogueIdentifier** is depicted in Figure 32 and defined in S-100 Appendix 4a-D. The value of sub-attribute *S100\_CatalogueIdentifier>identifier* must be chosen so that a 1/1 mapping from exchange set name to catalogue identifier is recommended. This assumes a system for assigning unique names to exchange sets – as opposed to datasets – is developed, either by the producer or in this specification. Note that an exchange set may contain multiple datasets.

## Metadata about feature and other catalogues

**S100\_CatalogueMetadata** describes feature, portrayal, and interoperability catalogues. This is an optional element that allows for descriptions of feature, interoperability, and portrayal catalogues that are delivered within the exchange set. This class is described in S-100 Part 4a Appendix 4a-D. S-128 uses the S-100 class without modification, with the following constraints on allowed values:

1. Attribute *productSpecification*: For feature and portrayal catalogues, the values of sub-attributes *name* and *version* must correspond to this version of the S-128 product specification. (Clause 4.2). For interoperability catalogues, the values of sub-attributes *name* and *version* must correspond to the appropriate version of the S-98 product specification.
2. Attribute *productSpecification*: The value of sub-attribute *number* must be the number assigned to this version of the S-128 product specification in the GI registry. For interoperability catalogues, the values of sub-attribute *number* must correspond to the appropriate version of the S-98 product specification.

# Appendix X. Feature Catalogue

**Name:** Catalogue of Nautical Products

**Scope:**

**Version Number:** 0.7.5

**Version Date:** 2019-11-20

**Producer:**

International Hydrographic Bureau,
4 quai Antoine 1er,

B.P. 445

MC 98011 MONACO CEDEX

Telephone: +377 93 10 81 00

Telefax: + 377 93 10 81 40

**Language:** English

(See Annex with review print of Feature Catalogue.)

# Appendix X. Data Classification and Encoding Guide

|  |
| --- |
| IHO Definition: **FEATURE:** Definition. (Authority for definition). |
| **S-101 Geo Feature: Feature (S-57 Acronym)** S-101 feature and corresponding S-57 acronym |
| **Primitives: Point, Curve, Surface** Allowable geometric primitive(s) |
| *Real World*Example of real world instance(s) of the Feature. | *Paper Chart Symbol*Example(s) of paper chart equivalent symbology for the Feature. | *ECDIS Symbol*Example(s) of ECDIS symbology for the Feature. |
| **S-101 Attribute** | **S-57 Acronym** | **Allowable Encoding Value \*** | **Type** | **Multiplicity** |
| Category of beer  |  | 1 : ale2 : lager3 : porter4 : stout5 : pilsener6 : bock beer7 : wheat beer | EN | 1,1 |
| This section liststhe full list of allowable attributes for the S-101 feature. Attributes are listed in alphabetical order. Sub-attributes (Type prefix (S)) of complex (Type C) attributes are listed in alphabetical order and indented directly under the entry for the complex attribute (see below for example). | This section liststhe corresponding S-57 attribute acronym. A blank cell indicates no corresponding S-57 acronym. | This section liststhe allowable encoding values for S-101 (for enumerate (E) Type attributes only). Further information about the attribute is available in Section XX. | Attribute type (see clause X.X). | Multiplicity describes the “cardinality” of the attribute in regard to the feature. See clause X.X. |
| Fixed date range |  |  | C | 0,1  |
|  Date end | (DATEND) |  | (S) DA | 0,1 |
|  Date start | (DATSTA) |  | (S) DA | 0,1 |
| INT 1 Reference: The INT 1 location(s) of the Feature – by INT1 Section and Section Number.**X.X.X Sub-clause heading(s) (see S-4 – B-YYY.Y)**Introductory remarks. Includes information regarding the real world entity/situation requiring the encoding of the Feature in the ENC, and where required nautical cartographic principles relevant to the Feature to aid the compiler in determining encoding requirements.Specific instructions to encode the feature.Remarks:* Additional encoding guidance relevant to the feature.

**X.X.X.X Sub-sub-clause heading(s) (see S-4 – B-CCC.C)**Clauses related to specific encoding scenarios for the Feature. (Not required for all Features).Remarks:* Additional encoding guidance relevant to the scenario (only if required).

Distinction: List of features in the Product Specification distinct from the Feature. |

Feature Attributes and Enumerate Proposals

|  |
| --- |
| **Attribute Name:** IHO Definition:1. **Enumerate Name**

IHO Definition: If Applicable1. **Enumerate Name**

Remarks: |

|  |
| --- |
| **Attribute Name:** IHO Definition:Unit:Resolution:Format:Example:Remarks:* No remarks.
 |

Associations/Aggregations/Compositions

|  |
| --- |
| **Association/Aggregation/Composition Name:** IHO Definition:Remarks: |
| **Role Type** | **Role** | **Features** | **Multiplicity** |
| AssociationAggregationComposition |  |  |  |
|  |  |  |
|  |  |  |