INLAND ENC HARMONIZATION GROUP

IEHG INLAND ELECTRONIC NAVIGATIONAL CHART PRODUCT SPECIFICATION

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~~September~~October ~~2019~~20254

IEHG Publication S-401

Inland Electronic Navigational Chart Product Specification

NOTE: S-401 has various components that are in development. ~~Therefore until it is at a final draft stage various items such as the main document, feature catalogue and encoding guide are not fully harmonized.~~

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~~Draft 0.0.2~~	~~July 2017~~	~~Gert Morlion~~	~~Comparing of the S101PS draft to S401PS draft~~
~~Draft 0.0.2~~	~~April 2018~~	~~Gert Morlion~~	~~Check of definitions~~ ~~Review~~
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~~Draft 1.0.0~~	~~November 2019~~	~~Gert Morlion~~	~~Amending last decisions IEHG and cleanup document~~

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Document History

Changes to this Specification are coordinated by the Inland ENC Harmonization Group (IEHG)~~S-101 Project Team (S-101PT), a Project Team under the IHO S-100 Working Group (S-100WG)~~. New editions will be made available via the IEHG website https://ienc.openecdis.org and the S-100 Registry~~IHO web site~~. ~~Maintenance of the Specification shall conform to .~~

Version Number	Date	Approved By	Purpose
S-101 Draft 0.0.2	July 2017	J.Powell	Incorporated the decisions from S101PT1 and updated some editorial issues. Numbering remained the same to be consistent with the DCEG numbering.
Draft 0.0.2	July 2017	Gert Morlion	Comparing of the S101PS draft to S401PS draft
Draft 0.0.2	April 2018	Gert Morlion	- Check of definitions Review
Draft 0.0.2	June 2018	Gert Morlion	Removed all definitions of commission regulation after workgroup meeting
Draft 0.0.3	February 2019	Gert Morlion	Comparison with the final version of the S-101 PS. Last additions are marked in yellow
Draft 0.0.3	April 2019	Gert Morlion	Resolving comments and issues
Draft 1.0.0	November 2019	Gert Morlion	Amending last decisions IEHG and cleanup document
Draft 1.1.0	June 2023	Gert Morlion	Updating to PS S-101 edition 1.1.0
Draft 1.2.0	September 2024	Gert Morlion	Comparison with S-101 PS edition 1.4.1
Draft 1.2.0	November 2024	Gert Morlion	Replacing copyright by permission Changing figures 11-1, 11-2, 11-3, 11-4
Draft 1.2.0	June 2025	Bernd Birklhuber	Alignment with edition 2.0.0 of S-101
Edition 1.2.0	October 2025	IEHG	Publication

Kommentiert [BB1]: Do we keep this sentence?

The resolution includes e.g. the definition of First Editions, New Editions, Revisions and Clarifications, but is explicitly referring to IHO member states, HO, procedures of IHO.

I think we should delete the sentence.

IEHG delete

Summary of Substantive Changes in Edition 1.2.0

Bold references in the Clauses Effected column indicate the principle sections/clauses that are impacted by the described change.

Change Summary	Clauses Affected

Kommentiert [BB2]: Should we fill in the table because edition 1.0.0 of the PS has been published on the registry or do we only start to record changes after edition 2.0.0?

The table is empty in S-101 edition 2.0.0
IEHG: keep empty table

Introduction

S-401 is the Electronic Navigational Chart Product Specification, produced by the Inland ENC Harmonization Group (IEHG). S-401 is designed to allow content, content definition (Feature Catalogues) and presentation (Portrayal Catalogues) to be updateable without breaking system implementations.

Based on the IHO Universal Hydrographic Data Model S-100, S-401 includes all the necessary pieces for all chart producers to produce Inland Electronic Navigational Charts (IENC) and OEMs to be able to ingest and properly display them. This Product Specification is designed to be flexible with the introduction of machine readable Feature and Portrayal Catalogues that will allow for managed change and will enable the introduction of new navigationally significant features and their portrayal ~~using a "just in time" methodology~~.

Kommentiert [BB3]: We will have to discuss in Europe how we can do that within the legal framework of the EU

Do we simply keep the text as it is as a description of technical possibilities? The legal restrictions are different for different regions.

COMEX2: delete just "using a just in time methodology"

IEHG yes

1 Overview

1.1 Scope

This document describes an S-100 compliant product specification for Inland Electronic Navigational Charts, which will form the base navigation layer for an S-100 based Inland ECDIS or ECS. It specifies the content, structure, and metadata needed for creating a fully compliant S-401 IENC and for its portrayal within an S-100 Inland ECDIS or ECS. This product specification includes the content model, the encoding, the feature catalogue, portrayal catalogue, metadata, implementation guidance for developers.

1.2 References

S-52 *IHO Specifications for Chart Content and Display Aspects of ECDIS*, Edition 6.1(.1) – October 2014, with Clarifications up to June 2015

S-100 IHO Universal Hydrographic Data Model

ISO 639-2/T *Codes for the representation of names of languages – Part 2: Alpha-3 code*

ISO 3166-1 *Codes for the Representation of Names of Countries and their Subdivisions – Part 1: Country Codes*

ISO/IEC 8211:1994 *Specification for a Data Descriptive File for Information Interchange Structure Implementations*

ISO 8601:2004 *Data Elements and Interchange Formats – Information Interchange – Representation of Dates and Times*

ISO 19101:2003 *Geographic Information – Reference Model*

ISO 19103:2005 *Geographic Information – Conceptual Schema Language*

ISO 19103-2:2005 *Geographic Information – Conceptual Schema Language – Part 2*

ISO 19105:2000 *Geographic Information – Conformance and Testing*

ISO 19107:2003 *Geographic Information – Spatial Schema*

ISO 19108:2002 *Geographic Information – Temporal Schema*

ISO 19109:2005 *Geographic Information – Rules for Application Schema*

ISO 19110:2005 *Geographic Information – Methodology for Feature Cataloguing*

ISO 19111:2007 *Geographic Information – Spatial Referencing by Coordinates*

ISO 19113:2002 *Geographic Information – Quality Principles*

ISO 19115-1 *Geographic information – Metadata – Part 1 - Fundamentals*. As amended by Amendment 01 (2018)

ISO/TS 19115-3 *Geographic information - Metadata - XML schema implementation for fundamental concepts*

ISO 19117:2012 *Geographic Information – Portrayal*

ISO 19118:2005 *Geographic Information – Encoding*

ISO 19131:2008 *Geographic Information – Data Product Specifications*

ISO/TS 19138:2006 *Geographic Information – Data Quality Measures*

ISO 19157:2013 *Geographic Information – Data Quality*

ISO/IEC 19501:2005 *Information Technology – Unified Modelling Language (UML)*, Version 1.4.2

FIPS 186 Federal Information Processing Standards – Digital Signature Standard

1.3 Terms, definitions and abbreviations

1.3.1 Use of Language

Within this document:

- "Must" indicates a mandatory requirement. "Shall" can be used as a synonym.
- "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.

1.3.2 Terms and Definitions

~~<<Terms and Definitions will be continually modified and finalized towards the end of the development of the S-401 Product Specification>>~~

Kommentiert [GM4]: Deleted in S101 PS

Kommentiert [BB5R4]: IEHG: delete

Accuracy
Closeness of agreement between a test result and the accepted reference values.

~~NOTE A test result can be from an observation or measurement.~~

Kommentiert [GM6]: Deleted in S101 PS

Kommentiert [BB7R6]: IEHG: delete

Aggregation
Special form of association that specifies a whole-part relationship between the aggregate (whole) and a component part.

Alarm
(MSC.302/A) a high-priority alert. Condition requiring immediate attention and action by the bridge team, to maintain the safe navigation of the vessel.

Alert
(MSC.302/A) announcement of abnormal situations and conditions requiring attention. Alerts are divided in four priorities: emergency alarms, alarms, warnings and cautions. An alert provides information about a defined state change in connection with information about how to announce this event in a defined way to the system and the operator

Application Schema
Conceptual schema for data required by one or more applications

Association
Semantic relationship between two or more classifiers that specifies connections among their instances.

Attribute
(1) Named property of an entity.

NOTE Describes a geometrical, topological, thematic, or other characteristic of an entity

(2) Feature within a classifier that describes a range of values that instances of the classifier may hold.

NOTE An attribute is semantically equivalent to a composition association; however, the intent and usage is normally different.

NOTE "Feature" used in this definition is the UML meaning of the term

Boundary
Set that represents the limit of an entity.

NOTE Boundary is most commonly used in the context of geometry, where te set is a collection of points or a collection of objects that represent those points.

Caution
(MSC.302/A) lowest priority of an alert. Awareness of a condition which does not warrant an alarm or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information.

Class
Description of a set of objects that share the same **attributes**, operations, methods, **relationships**, and semanetics.

NOTE A class represents a concept within the system being modelled. Depending on the kind of model, the concept may be real-world (for an analysis model), or it may also contain algorithmic and computer implementation concepts (for a design model). A classifier is a generalization of class that includes other class-like elements, such as data type, actor and component.

Classification
The process of determining the appropriate **data type** within a feature catalogue for a particular real world feature, including consideration of data quality.

Composition
Form of **aggregation association** with strong ownership and coincident lifetime as part of the whole.

NOTE: Parts with non-fixed multiplicity may be created after the composite itself, but once created they live and die with it (that is, they share lifetimes). Such parts can also be explicitly removed before the death of the composite. Composition may be recursive. Synonym: Composite aggregation.

Coordinate
One of a sequence of n numbers designating the position of a **point** in n-dimensional space.

NOTE In a **coordinate reference system**, the coordinate numbers are qualified by units.

Coordinate Reference System
Coordinate system that is related to an object by a datum.

NOTE For geodetic and vertical datums, the object will be the Earth.

Coordinate Tuple
Ordered list of **coordinates** where the number and order of coordinates is identical to the axes of the **coordinate reference system**.

Curve
1-dimensional **geometric primitive**, representing the continuous image of a line.

NOTE The boundary of a curve is the set of points at either end of the curve. If the curve is a cycle, the two ends are identical, and the curve (if topologically closed) is considered to not have a boundary. The first point is called the start point, and the last is the end point. Connectivity of the curve is guaranteed by the "continuous image of a line" clause. A topological theorem states that a continuous image of a connected set is connected.

Curve Segment
1-dimensional geometric object used to represent a continuous component of a **curve** using homogeneous interpolation and definition methods.

NOTE The geometric set represented by a single curve segment is equivalent to a curve.

Data Product
A **dataset** or dataset series that conforms to a data product specification.

Data Quality
A set of elements describing aspects of quality, including a measure of quality, an evaluation procedure, a quality result, and a scope.

Data Type
Specification of a value domain with operations allowed on values in this domain.

NOTE Data types include primitive predefined types and user-definable types.

NOTE A data type is identified by a term, for example Integer.

EXAMPLES: Integer, Real, Boolean, String, DirectPosition and and S_100_TruncatedDate~~Date~~

Dataset
An identifiable collection of data

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 contained within a larger dataset. A hardcopy map or chart may be considered a dataset.

Datum
Parameter or set of parameters that define the position of the origin, the scale, and the orientation of a **coordinate** system.

Display Priority
Display priorities control the order in which the output of the portrayal functions is processed by the rendering engine. Priorities with smaller numerical values will be processed first. Instructions which have equal display priority must be ordered so that area instructions are rendered first, followed by line instructions, then point instructions, and lastly text instructions. If the display priority is equal among the same type of instruction (area, line, point, or text) some other neutral criterion must be used to order the instructions.

~~Hierarchy to determine which **feature** is to be displayed when two features overlap. Priority 2 overwrites 1~~

ECDIS
A navigation information system which with adequate back-up arrangements can be accepted as complying with the up-to-date chart required by regulations V/19 and V/27 of the 1974 SOLAS Convention, as amended, by displaying selected information from a system electronic navigational chart (SENC) with positional information from navigation sensors to assist the Mariner in route planning and route monitoring, and if required display additional navigation-related information.

ECDIS Chart 1
An ECDIS version of INT 1, including all symbols, line styles and colour coding used for chart presentation. Intended for the Mariner to both familiarize himself with ECDIS and to look up specific symbols.

ECS
An electronic charting system

Emergency Alarm
(MSC.302/A) highest priority of an **alert**. A condition presenting an immediate danger to human life or to the vessel and its machinery exists and that immediate action must be taken.
ENC

The dataset, standardized as to content, structure and format, issued for use with ECDIS by or on the authority of a Government authorized Hydrographic Office or other relevant government institution, and conform to IHO standards. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart which may be considered necessary for safe navigation.

ENDS
A special-purpose database compiled from nautical chart and nautical publication data, standardized as to content, structure and format, issued for use with **ECDIS** by or on the authority of a Government, authorized Hydrographic Office or other relevant government institution, and conforming to IHO standards; and, which is designed to meet the requirement of marine navigation and the nautical charts and nautical publications carriage requirements in SOLAS regulations V/19 and V/27. The navigational base layer of ENDS is the Electronic Navigational Chart (**ENC**).

Enumeration
A fixed list of valid identifiers of named literal values. **Attributes** of an enumeration~~ed~~ type may only take values from this list.

Feature
Abstraction of real world phenomena.

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

EXAMPLE The phenomenon named 'London Eye' may be classified with other phenomena into a feature type 'landmark'

Feature Association
Relationship that links instances of one **feature** type with instances of the same or a different **feature** type.

Feature Attribute
Characteristic of a **feature**.

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

NOTE In a **feature catalogue**, a feature **attribute** may include a value domain but does not specify **attribute** values for feature instances.

EXAMPLE 1: A feature attribute named *communication channel* may have an attribute value *VHF0007* which belongs to the data type *text*

EXAMPLE 2: A feature attribute named *length* may have an attribute value *82.4* which belongs to the data type *real*

Feature Catalogue
A catalogue containing definitions and descriptions of the **feature** types, **feature attributes**, and **feature associations** occurring in one or more sets of geographic data.

Geometric Primitive
A plain point, a plain curve, a plain surface as defined in geometry (That is without any meaning attached).

NOTE Geometric primitives are non-decomposed objects that present information about geometric configuration. They include points, curves, surfaces, and solids.

Human Readable
A representation of information that can be naturally read by humans.

Identifier
A linguistically independent sequence of characters capable of uniquely and permanently identifying that with which it is associated.

IENC
The dataset, standardized as to content, structure and format, for use with inland electronic chart display and / or information systems operated onboard of vessels transiting inland waterways. An IENC is issued by or on the authority of a competent government agency, and conforms to standards initially developed by the International Hydrographic Organization (IHO) and refined by the Inland ENC Harmonization Group. An IENC contains all the chart information necessary for safe navigation on inland waterways and may contain supplementary information in addition to that contained in the paper chart (for example sailing directions, machine-readable operating schedules, etc.) which may be considered necessary for safe navigation and voyage planning. [IENC Encoding Guide, Edition 2.6 October 2024]

Kommentiert [GM8]: Changing to latest edition IENC Encoding Guide?

Kommentiert [BB9R8]: IEHG: 2.6

Indication
Visual indication giving information about the condition of a system or equipment.

Instance
Entity to which a set of operations can be applied and which has a state that stores the effects of the operations.
NOTE See **feature**.

Inland ECDIS
An Electronic Chart Display and Information System for inland navigation, displaying selected information from a Inland System Electronic Navigational Chart (Inland SENC) and optionally, information from other navigation sensors.

Machine Readable
A representation of information that can be processed by computers.

Maximum Display Scale
The value considered by the Data Producer to be the maximum (largest) scale at which the data is to be displayed before it can be considered to be "grossly overscaled".

~~The larger value of the ratio of the linear dimensions of features of a dataset presented in the display and the actual dimensions of the features represented (largest scale) of the scale range of the dataset.~~

Metadata
Data about data.

Minimum Display Scale
The minimum (smallest) scale with which the data is intended to be displayed.

~~The smaller value of the ratio of the linear dimensions of features of a dataset presented in the display and the actual dimensions of the features represented (smallest scale) of the scale range of the dataset.~~

Model
Abstraction of some aspects of universe of discourse.

NOTE A semantically complete abstraction of a system.

Multiplicity
Specification of the number of possible occurrences of a property, or the number of allowable elements that may participate in a given relationship.

EXAMPLES: 1..* (one to many); 1 (exactly one); 0..1 (zero or one)

Optimum Display Scale
The maximum (largest) scale with which the data is intended to be displayed.

NOTE: Optimum Display Scale may be considered to be the compilation scale for the data, and is the reference for the overscale indication. When the ~~Mariners~~Boatmasters Selected Viewing Scale (B~~M~~SVS) is set to a scale that is larger than Optimum Display Scale, this triggers the overscale indication in the end user system.

Kommentiert [BB10]: IEHG: Change to BSVS (boatmasters selected viewing scale)

Overscale
The viewing scale is larger than the value considered by the data producer to be the largest intended (maximum) display scale for the data.

Point
0-dimensional **geometric primitive**, representing a position.

NOTE The **boundary** of a point is the empty set.

Pointset
A set of **points** in geometric space.

Portrayal Catalogue
Collection of defined portrayals for a **feature catalogue**.

NOTE Content of a portrayal catalogue includes portrayal functions, symbols, and portrayal context.

Radar Priority
The IMO ECDIS Performance Standard requires that radar can be switched off with a "single action control" in order to see SENC and Skippers info clearly. However certain other info, such as planned route, safety contour, coastline should always be written over the radar.

Radar Transparency
A method of varying the transparency of radar in a continuous progression from no radar to a totally opaque radar overlay, by merging the radar colour with the colour of the feature it overlays at each pixel

Record
Finite, named collection of related items (objects or values).

NOTE Logically, a record is a set of pairs <name, item >.

Relationship
Semantic connection among model elements.

NOTE Kinds of relationships include association, generalization, metarelationship, flow, and several kinds grouped under dependency.

Scale Minimum
The smallest scale at which an feature is displayed (For example, a minor light, SCAMIN of 1:45,000, would not be displayed at a scale of 1:90,000).

SENC
In **ECDIS** means a database, in the manufacturer's internal Inland ECDIS or ECS format, resulting from the loss-less transformation of the entire **IENC** contents and its updates. It is this database that is accessed by Inland ECDIS or ECS for the display generation and other navigational functions, and is equivalent to an up-to-date paper chart. The SENC may also contain information added by the skipper and information from other sources.

Skin of the Earth

A defined set of non-overlapping geographic features of geometric primitive surface, covering an area equivalent to that of meta-features **Data Coverage**.

Surface
Connected 2-dimensional geometric primitive, representing the continuous image of a region of a plane.

NOTE The boundary of a surface is the set of oriented, closed curves that delineate the limits of the surface.

Symbol Size
The size is specified in normalized units of 0.01 mm. The minimum dimension is always more than 4 mm. This size applies to display on a standard minimum screen.

System Database
A database, in the manufacturer's internal ECDIS format, resulting from the lossless transformation of the Electronic Navigational Data Service (ENDS) contents and its updates. It is this database that is accessed by ECDIS for the display generation and other navigational functions, and is equivalent to up-to-date ENDS.

Temporal Reference System
Reference system against which time is measured.

Text Label
A textual description of an **feature**. Can be formatted to include standard text as well as **feature attribute** values. For example, light descriptions, place names etc.

Transparent Fill
A method of identifying features of **geometric primitive surface** by covering a given percentage of each 4 pixel square with the fill colour, leaving the remainder "transparent". Used to ensure the information underneath shows through.

Vertical Datum
Datum describing the relation of gravity-related heights or depths to the Earth.

Warning
(MSC.302/A) alert for condition requiring immediate attention, but no immediate action by the bridge team. Warnings are presented for precautionary reasons to make the bridge team aware of changed conditions which are not immediately hazardous, but may become so if no action is taken.

1.3.3 Abbreviations

BSVS	Boatmasters Selected Viewing Scale
CRS	Coordinate Reference System
DCEG	Data Classification and Encoding Guide
ECDIS	Electronic Chart Display and Information System
ECS	Electronic Chart System
EPSG	European Petroleum Survey Group
ENC	Electronic Navigational Chart
ENDS	Electronic Navigational Data Service
EPSG	European Petroleum Survey Group
GFM	General Feature Model
IEC	International Electrotechnical Commission
IENC	Inland Electronic Navigational Chart
IEHG	Inland ENC Harmonization Group
Inland ECDIS	Inland Electronic Chart Display and Information System
IHO	International Hydrographic Organization
IMO	International Maritime Organization

ISO	International Organization for Standardization
~~SSVS~~	~~Skippers Selected Viewing Scale~~
SENC	System Electronic Navigational Chart
SOLAS	Safety of Life at Sea
SVG	Scalable Vector Graphics
S-100WG	IHO S-100 Working Group
S-101PT	S-100WG – S-101 Project Team
TIFF	Tagged Image File Format
UML	Unified Modelling Language
URL	Universal Resource Locator
XML	Extensible Markup Language

1.4 S-401 General Data Product Description

NOTE This information contains general information about the data product.

Title: **Inland** Electronic Navigational Chart

Abstract: An Inland Electronic Navigational Chart (IENC) is a vector chart produced on the authority of a regional or national waterway authority. Its primary purpose is for use within an Inland Electronic Chart Display and Information Systems (ECDIS) or an Electronic Chart System (ECS) . The IENC contains an extraction of real world information necessary for the safe navigation of vessels on inland waterways.

Content: The Product Specification defines all requirements to which IENC data products must conform. Specifically it defines the data product content in terms of features and attributes within the feature catalogue. The display of features is defined by the symbols and rule sets contained in the portrayal catalogue. The Data Classification and Encoding Guide for Inland ENCs provides guidance on how data product content must be captured. (Annex A) ~~In addition, Annex C will provide implementation guidance for developers.~~

Kommentiert [GM11]: Deleted in S-101 PS

Kommentiert [BB12R11]: IEHG:delete

Spatial Extent:

Description: Areas specific to inland navigation.

East Bounding Longitude: 180°

West Bounding Longitude: -180°

North Bounding Latitude: 90°

South Bounding Latitude: -90°

Purpose: The purpose of an IENC dataset is to provide official navigational data to an Inland Electronic Chart Display and Information System (Inland ECDIS) or an Electronic Chart System (ECS) for the safe passage and route planning of vessels between destinations on inland waterways.

1.5 Data product specification metadata

NOTE This information uniquely identifies this Product Specification and provides information about its creation and maintenance. For further information on dataset metadata see clause 12.

Title: The Inland ENC Harmonization Group (IEHG) Inland Electronic Navigational Chart Product Specification

S-100 Version: 54.20.0

S-401 Version: 1.20.0

Date: October 20254519

Language: English

Classification: Unclassified

Contact: Inland ENC Harmonization Group (IEHG)

Core Group, see contact details at https://ienc.openecdis.org/terms-of-reference-and-list-of-members
denise.r.ladue@usace.army.mil
bernd.birklhuber@bmvit.gv.at
jose.celso@marinha.mil.br
fwj@wti.ac.cn
ybaek@korea.kr
cameron.mcleay@caris.us
g.billet@periskal.com
vladimir.sekachev@gmail.com
nuno.silva@iictechnologies.com

URL: https://ienc.openecdis.org

Identifier: S-401

Maintenance: Changes to the Product Specification S-401 are coordinated by the Inland ENC Harmonization Group and must be made available via https://ienc.openecdis.org and the S-100 registry. Maintenance of the Product Specification must conform to the Terms of Reference of IEHG.

The IEHG submits Inland ENC standards for formalization to:

- Interested international organizations like IHO, the European Commission (EC), and the Central Commission for Navigation on the Rhine (CCNR) via the European Committee for drawing up standards in the field of inland navigation (CESNI), the Danube Commission (DC), the Economic Commission for Europe of the United Nations (UN/ECE), the Mekong River Commission,
- National competent authorities.

1.6 IEHG Product Specification Maintenance

1.6.1 Introduction

Changes to S-401 will be released as a new edition, revision, or clarification by the different regional organizations.

1.6.2 New Edition

New Editions of S-401 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.

Kommentiert [GM13]: Still correct?

Kommentiert [BB14R13]: IEHG check before publication

Kommentiert [GM15]: Change date after finalizing new edition…

Kommentiert [BB16R15]: Will be set when adopted

Kommentiert [GM17]: Change to new vice-chairs

Kommentiert [GM18R17]: Core group?

Kommentiert [BB19R17]: IEHG: yes, reference to TOR on website

New Editions are likely to have a significant impact on either existing users or future users of S-401. All cumulative *revisions* and *clarifications* must be included with the release of approved New Editions.

1.6.3 Revisions

Revisions are defined as substantive semantic changes to S-401. Typically, revisions will change S-401 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 of S-401. All cumulative *clarifications* must 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 Pportrayal Ccatalogues.

In most cases a new feature catalogue or Pportrayal Ccatalogue will result in a revision of S-401.

1.6.4 Clarification

Clarifications are defined as non-substantive changes to S-401. Typically, *clarifications*: remove ambiguity; correct grammatical and spelling errors; amend or update cross references; and insert improved graphics. A *clarification* must not cause any substantive semantic change to S-401.

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

1.6.5 Version Numbers

The associated version control numbering to identify changes (n) to S-401 must be as follows:

New Editions denoted as **n**.0.0

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

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

2 Specification Scopes

Scope ID: Global

Level: 006- series

Level name: IENC Dataset

3 Dataset Identification

A dataset that conforms to this Product Specification may be identified by its discovery metadata as defined in clause 12.

Title: Inland Electronic Navigational Chart

Alternate Title: IENC

Abstract:

S-401 ENCs must be produced in accordance with the rules defined in the S-401 Product Specification. The S-401 Product specification contains all the information necessary to enable chart producers to produce a consistent IENC, and manufacturers to use that data efficiently within Inland ECDIS or ECS.

Topic Category:

Transportation (ISO 19115-1 MD_TopicCategroyCode 018)

Geographic Description:

Areas specific to inland waterway navigation.

Spatial Resolution:

An IENC dataset and **Data Coverage** must carry a value for ~~maximum~~ optimum display scale. Each **Data Coverage** must also carry a value for maximum and minimum display scale. Values for optimum and minimum display scales must be taken from the following table:

~~Maximum Display Scale~~	~~Minimum Display Scale~~
~~1:10,000,000~~	~~NULL (only allowed on minimum display scale where the maximum display scale = 10,000,000)~~
~~1:3,500,000~~	~~1:10,000,000~~
~~1:1,500,000~~	~~1:3,500,000~~
~~1:700,000~~	~~1:1,500,000~~
~~1:350,000~~	~~1:700,000~~
~~1:180,000~~	~~1:350,000~~
~~1:90,000~~	~~1:180,000~~
~~1:45,000~~	~~1:90,000~~
~~1:22,000~~	~~1:45,000~~
~~1:12,000~~	~~1:22,000~~
~~1:8,000~~	~~1:12,000~~
~~1:4,000~~	~~1:8,000~~
~~1:3,000~~	~~1:4,000~~
~~1:2,000~~	~~1:3,000~~
~~1:1,000~~	~~1:2,000~~
~~1:100~~	

Scale
NULL (only allowed on minimum display scale (data will continue to be displayed at all smaller scales))
1:10,000,000
1:3,500,000
1:1,500,000
1:700,000
1:350,000
1:180,000

Kommentiert [BB20]:
IEHG; table has been updated in S-101

As we do not produce different IENCs for different usages the ranges might be too small. Do we keep the table, change it, or delete it?

IEHG: for inland we need much bigger scale ranges (e.g. 1:200 – 1:100 00

Kommentiert [BB21R20]: In S-101 Ed 2.0.0 only one column
Do we change the last line(s)?
It seems not to be forbidden to define a big range

COMEX2: amendments accepted

IEHG yes

1:90,000
1:45,000
1:22,000
1:12,000
1:8,000
1:4,000
1:3,000
1:2,000
1:1,000 ~~(only allowed on optimum and maximum display scale)~~
1:500
1:200 (only allowed on optimum and maximum display scale)

Table 3-1 – IENC Minimum Display and Optimum Display Scales

Purpose: Inland Electronic Navigational Chart for use in Inland Electronic Chart Display and Information Systems or Electronic Chart Systems.

Language: English (Mandatory), other (Optional)

Classification: Data may be classified as one of the following:

1) Unclassified
2) Restricted
3) Confidential
4) Secret
5) Top Secret
6) Sensitive but Unclassified
7) For Official Use Only
8) Protected
9) Limited Distribution

Spatial Representation Type: Vector

Point of Contact: Producing Agency

Use Limitation: Not to be used for navigation on land.

4 Data Content and structure

4.1 Introduction

An S-401 IENC is a feature-based product. The content information is described in terms of a general Feature Model and a Feature Catalogue.

4.2 Application Schema

S-401 conforms to the General Feature Model (GFM) from S-100 Part 3. The GFM is the conceptual model and the implementation is defined in the Feature Catalogue. The S-401 Application Schema is realised in the feature catalogue and the product specification only contains specific examples.

4.3 Feature Catalogue

4.3.1 Introduction

The S-401 Feature Catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in an IENC.

The S-401 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. S-401 Annex A – Data Classification and Encoding Guide, constitutes a human readable interpretation of the Feature Catalogue.

4.3.2 Feature Types

Details of feature types can be found in Annex A – *Data Classification and Encoding Guide*, clause 2.1 and Sections 3-23.

Kommentiert [GM22]: Added the clause and section numbers

Kommentiert [BB23R22]: All references have to be checked before publication

~~4.3.1.1~~4.3.2.1 Geographic

Geographic (geo) feature types form the principle content of the IENC and are fully defined by their associated attributes and information types.

Details of feature types can be found in Annex A – *Data Classification and Encoding Guide*, clause 2.1 and Sections 4-22.

Kommentiert [GM24]: Added the clause and section numbers

~~4.3.1.1.1~~4.3.2.1.1 Skin of the Earth

Details of feature comprising the Skin of the Earth can be found in Annex A – *Data Classification and Encoding Guide*, clause 2.5.1.1.

Kommentiert [GM25]: Added the clause and section numbers

~~Each area covered by a meta-feature **Data Coverage** must be totally covered by a set of geo features of geometric primitive type surface that do not overlap each other (the Skin of the Earth). Feature types that comprise the Skin of the Earth are listed below:~~

~~**Depth Area**~~

~~**Dredged Area**~~

~~**Land Area**~~

~~**Unsurveyed Area**~~

~~**Dock Area**~~

~~**Lock Basin**~~

~~The geometry of coincident boundaries between Skin of the Earth features in a dataset must not be duplicated.~~

~~4.3.1.2~~4.3.2.2 Meta~~data features~~

Details of metadata feature types can be found in Annex A – *Data Classification and Encoding Guide*, clause 2.1 and Section 3.

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

~~4.3.1.3~~4.3.2.3 Cartographic

Details of cartographic feature types can be found in Annex A – *Data Classification and Encoding Guide*, clause 2.1 and Section 23.

~~Cartographic features contain information about the cartographic representation (including text) of real world entities.~~

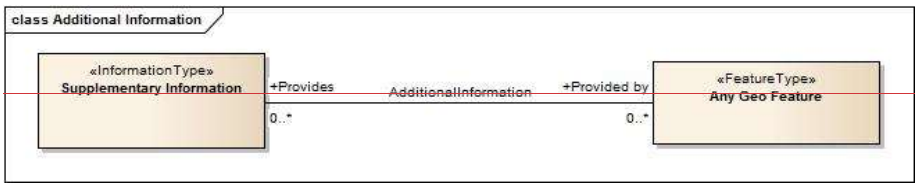
~~4.3.2~~4.3.3 Feature Relationship

A feature relationship links instances of one feature type with instances of the same or a different feature type. There are four types of defined feature relationships in S-401 as described in the following sub clauses.

~~4.3.2.1 Information Association~~

~~An information association is used to describe a relationship between a feature type, spatial object, or information type on one side and an information type on the other side.~~

~~EXAMPLE A **Supplementary Information** information type provides additional information to any geo feature using an information association called **additional information**.~~



~~**Figure 1 - Information Association**~~

~~4.3.2.2~~4.3.3.1 Feature Association

A feature association is used to describe a relationship between two feature types that involves connections between their instances.

EXAMPLE A **Caution Area** feature provides additional caution information to the **Traffic Separation Scheme** feature. An association named **Caution Area Association** is used to relate the two features; roles are used to convey the meaning of the relationship. ~~A **Light** feature provides additional information to the **bridge** feature. An association named **Bridge Association** is used to relate the features; roles are used to convey the meaning of the relationship.~~

Kommentiert [GM26]: Added the clause and section numbers

Kommentiert [GM27]: Added the clause and section numbers

Kommentiert [GM28]: Deleted in S-101!
IEHG: delete here

Kommentiert [BB29]: S-101 uses the example of Caution Area and Archipelagic Sea Lane, but the second feature is not part of S-401.
Which example do we use? Light and Bridge are associated via the Structure/Equipment composition and is therefore no adequate example.

COMEX2: to be clarified after finalization of associations

The Caution Area Association that is used in S-101 can also be used for S-401, but with Traffic Separation scheme instead of Archipelagic Sea Lane.

Figure needs to be amended

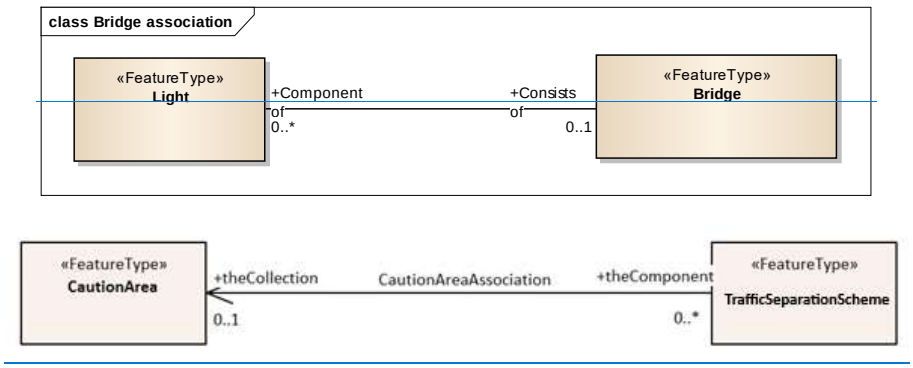
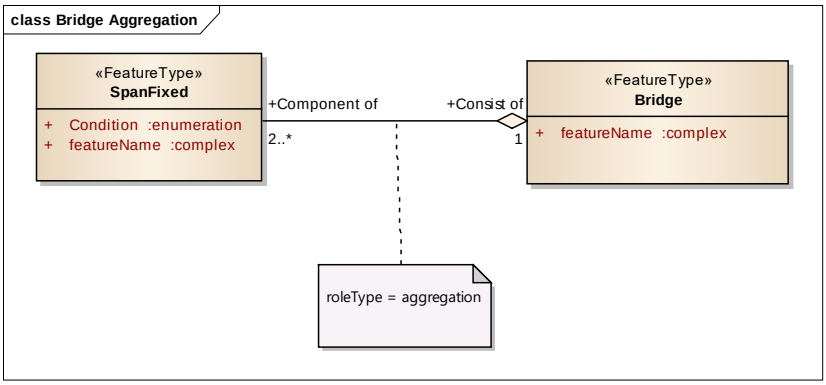


Figure 4-112 – Feature Association

~~4.3.2.3~~4.3.3.2 Aggregation

An aggregation is a relationship between two or more feature types where the aggregation feature is made up of component features.

EXAMPLE An **Bridge** feature may be composed of multiple **Span Fixed** features.



Kommentiert [GM30]: Is this still a correct example? roleType = association Type?

IEHG: correct

Figure 4-223 - Aggregation

~~4.3.2.4~~4.3.3.3 Composition

A composition is a strong aggregation. In a composition, if a container feature is deleted then all of its container features are deleted as well.

EXAMPLE If a feature type that is considered a structure feature, such as a beacon is deleted, then all of its component feature types that make up the equipment composition, such as lights and fog signals must be deleted as they make up the **Structure/Equipment** Composition.

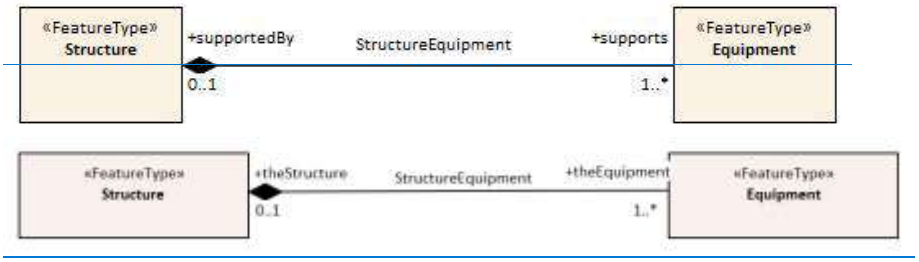


Figure 34-3 - Composition

4.3.34.3.4 Information Types

Details of information types can be found in Annex A – *Data Classification and Encoding Guide*, clause 2.3, 2.4.7 and Section 24.

Kommentiert [GM31]: Added the clause and section numbers

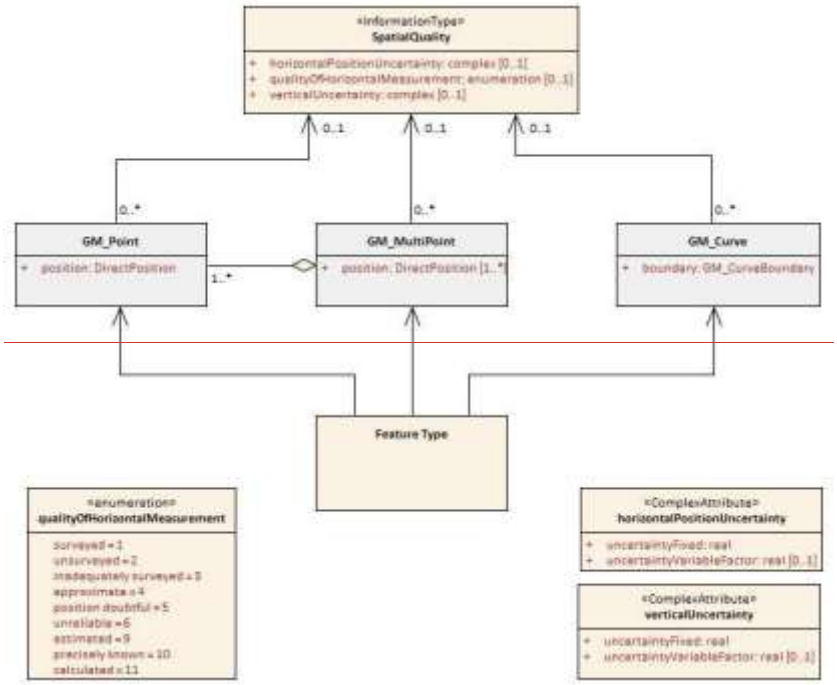
~~Information types define identifiable pieces of information in a dataset that can be shared using information associations They have attributes but have no geometry.~~

4.3.3.14.3.4.1 Spatial Quality

Spatial quality attributes are carried in an information class called **Spatial Quality**. Details of spatial quality can be found in Annex A – *Data Classification and Encoding Guide*, clauses 2.4.7 and 24.5.

~~The information association "Spatial association" provides the binding between spatial objects and spatial quality. It is noted here because the S-100 Feature Catalogue model is incapable of describing this relationship.~~

~~Any spatial type other than surface may be associated with spatial quality (no use case for associating surfaces with spatial quality attributes has been identified). Vertical uncertainty is prohibited for curves as this dimension is not supported by curves.~~ Spatial quality attributes are carried in an information class called **Spatial quality**. Only points, multipoints and curves can be associated with spatial quality. Currently no use case for associating surfaces with spatial quality attributes is known, therefore this is prohibited. Vertical uncertainty is prohibited for curves as this dimension is not supported by curves.



~~Figure 5 - Spatial Quality Information Type~~

4.3.5 Information relationships

An information relationship links instances of an information type with instances of a feature type, spatial object, or information type. Just as with feature relationships, the relationship may take the form of an association, aggregation, or composition.

4.3.5.1 Information association

An information association is used to describe a relationship between a feature type, spatial object, or information type on one side and an information type on the other side.

EXAMPLE: A **Nautical Information** information type provides additional information to any geo feature using an information association called **additional information**.

Figure 4-4 – Information association

4.3.5.2 Spatial associations

The information association “Spatial association” provides the binding between spatial objects and spatial quality. It is noted here because the S-100 Feature Catalogue model is incapable of describing this relationship.

Any spatial type other than surface may be associated with spatial quality (no use case for associating surfaces with spatial quality attributes has been identified). Vertical uncertainty is prohibited for curves as this dimension is not supported by curves.

~~4.3.4~~4.3.6 Attributes

S-401 defines attributes as either simple or complex.

~~4.3.4.1~~4.3.6.1 Simple Attributes

S-401 uses nine~~seven~~ types of simple attributes; these types are listed in Annex A – *Data Classification and Encoding Guide*, clause 2.4.2. Descriptions of the simple attributes included in S-401 can be found in Annex A, Sections 27, 28 and 30.

~~S-401 uses seven types of simple attributes; they are listed in the following table:~~

~~Type~~	~~Definition~~
~~Boolean~~	~~the value is a logical value either 'True' or 'False'~~
~~Integer~~	~~the value is an integer number~~
~~Real~~	~~the value is a floating point number~~
~~Enumeration~~	~~the value is one of a list of predefined values~~
~~Text~~	~~the value is general text. This is also defined as CharacterString~~
~~Truncated Date~~	~~the value is a date according to the Gregorian calendar, and allows for partial date to be provided~~
~~Time~~	~~the value is a 24 hour time, It may contain a time zone~~

~~**Table 2 - Simple Attribute Types**~~

~~4.3.4.2~~4.3.6.2 Complex Attributes

Complex attributes are aggregations of other attributes that are either simple or complex. The aggregation is defined by means of attribute bindings. Examples of modelling complex attributes can be found in S-100 Part 2a, Appendix 2a-A. Descriptions of the complex attributes included in S-401 can be found in Annex A – *Data Classification and Encoding Guide*, Section 29. ~~Bindings of complex attributes may be represented in UML by a composition (Figure 6, left, *BuoyLateral/topmark* and *topmark/shapeInformation* compositions) or a local attribute (Figure 6, right, *BuoyCardinal* attributes *topmark* and *featureName*). S-401 uses the convention on the right.~~

Kommentiert [GM32]: Check reference as soon as introduction DCEG is finalized.

Kommentiert [GM33]: Check reference as soon as introduction DCEG is finalized.

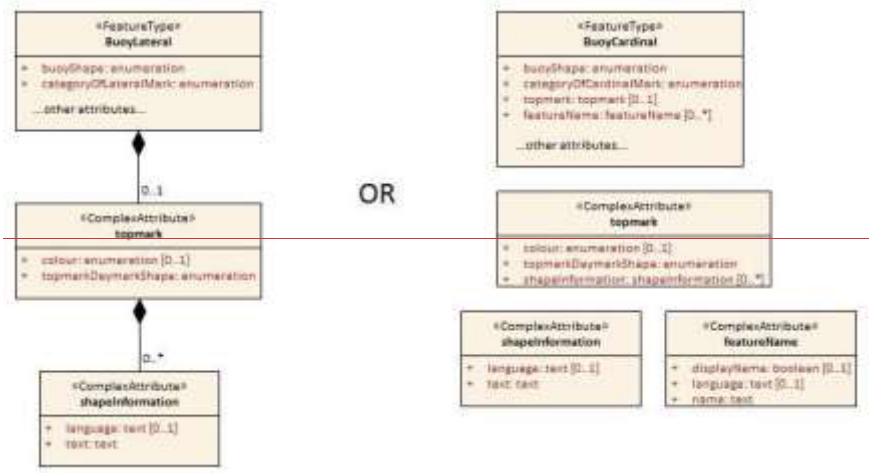


Figure 46 - Complex Attribute

~~EXAMPLE In the left example the complex attribute **topmark** has three sub attributes, one of which (**shape information**) is itself complex. The **Buoy Lateral** feature may optionally include one instance of **topmark**. In the right example the **Buoy Cardinal** feature may optionally include one instance of **topmark** (as for the left example) and one or more instances of **feature name**.~~

4.3.6.3 Attribute suppression

The S-100 XML Feature Catalogue Schema allows for attributes to be suppressed in the end-user system Pick Report using the attribute *attributeVisibility* for the class S100_FC_AttributeBinding (see S-100 Part 5, Appendix 5-A, Tables 5-A-16 and 5-A-21) . These attributes are generally used to assist with optimum display of features in Inland ECDIS or ECS systems; or to perform other administrative roles. For S-1401, these attributes are identified in the Feature Catalogue by population of *attributeVisibility* value "privateVisibility".

The following is the list of S-4101 attributes that will be suppressed in the Inland ECDIS or ECS Pick Report:

default clearance depth	~~**display priority**~~	**drawing index**
~~**drawing instruction**~~	**file locator**	**flare bearing**
in the water	**interoperability identifier**	**major light**
name usage	**sector arc extension**	**sector line length**
surrounding depth		

Kommentiert [JW34]: Refer to Paper S-101PT12-06.18 and Decisions and Actions from S-101PT12.

IEHG: keep and adapt

Kommentiert [BB35]: Check!
IEHG ok

Kommentiert [BB36]: Mentioned in S-101, but the S-401 DCEG is not containing such an attribute
IEHG yes

4.4 Feature Object Identifier

Each real world feature within an IENC must have a unique universal Feature Object Identifier. This identifier is formed by the binary concatenation of the contents of the subfields of the "Feature Object Identifier" [FOID] field. Information types must not have a FOID.

The FOID may be used to identify that the same feature has instances in separate datasets. For example the same feature included in different maximum display scale datasets, or a feature being split by the IENC dataset limits within the same maximum display scale.

FOIDs must not be repeated in a dataset. Where a real-world feature has multiple parts within a single IENC dataset due to IENC dataset limit truncations, the feature will reference each spatial part of the

feature within the dataset. This is accomplished in the ISO/EIC 8211 encoding by including a Spatial Association for each disjoint component. When a feature's geometry is split each component must be represented by a separate spatial feature that the feature refers to.

Where a real-world feature is repeated in datasets of different maximum display scale, the FOID should be repeated for each instance of the feature across the maximum display scale range. Where this occurs, all instances of the geo feature must be identical, that is same feature class and attribute values.

~~Feature Object Identifiers must not be reused by another feature, even when a feature has been deleted. The same feature can be deleted and added again later using the same FOID.~~

4.5 Dataset

4.5.1 Introduction

A dataset is a grouping of features, attributes, geometry and metadata which comprises a specific coverage.

4.5.2 Dataset rules

In order to facilitate the efficient processing of IENC data the geographic coverage of a given ~~maximum~~ optimum **display scale** may be split into multiple datasets (see clause 4.5.4).

The discovery metadata of a dataset must list all the **Data Coverage** features contained within that dataset and their assigned scale attributions.

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

A d~~D~~atase~~t~~s must not cross the 180° meridian~~; this includes both the **Data Coverage** features and the bounding box for the dataset~~.

4.5.3 Data Coverage rules

- All base datasets (new dataset, new edition and re-issue) must contain at least one **Data Coverage** feature.
- The data boundary of the IENC dataset is defined by the extent of the **Data Coverage** features and must be contained within the **bounding Box**.
- Data Coverage features from different datasets covering the same geographical area must have non-overlapping display scale ranges (see clause 4.6). The scale ranges should, as much as possible, be continuous.

  [Exception: At areas of agreed national data limits, where, if it is difficult to achieve a perfect join, an overlapping buffer zone of up to 5 metres may be used. For this situation, there must be no gaps in data between the adjoining datasets.]

  Data Producers should develop consistent S-41~~1~~01 ENC schemes carefully and try to avoid complex situations, using a regional approach where possible.

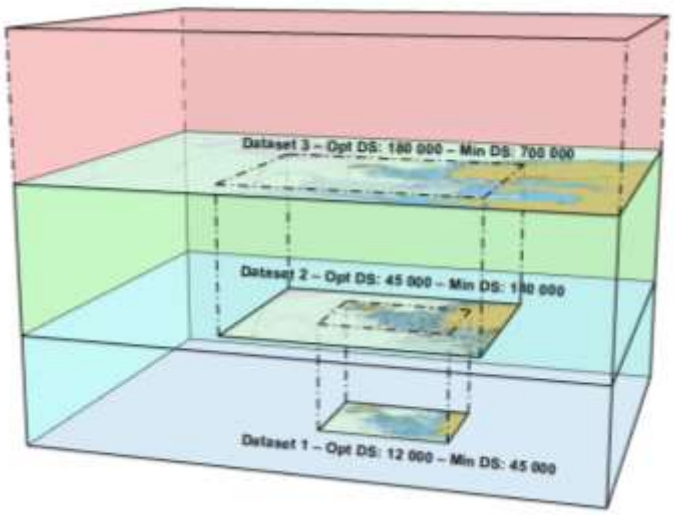


Figure 4-5 – Example of Datasets with single Data Coverage feature

- When a dataset has multiple **Data Coverage** features:

a. The **minimum display scale**s must all be the same
b. The **drawing index**es, where populated, must be the same.
c. The **optimum display scale**s may be different; and
d. The **maximum display scale**s may be different.

- When a dataset has multiple **Data Coverage** features then the **optimum~~maximum~~ display scale** of the dataset must be equal to the largest **optimum~~maximum~~ display scale** of the **Data Coverage** features.

* The attribute **drawing index** is required where the datasets intended to form a seamless presentation in Inland ECDIS or ECS do not share a common minimum display scale. The attribute **drawing index** is also required if the dataset may need to form a seamless presentation with one or more S-57 datasets, in which case the value should correspond to the usage band of the adjoining or overlapping S-57 dataset(s). See S-401 Annex A – *Data Classification and Encoding Guide*, clauses 3.5 and 28.3.

Kommentiert [BB37]: checked

-

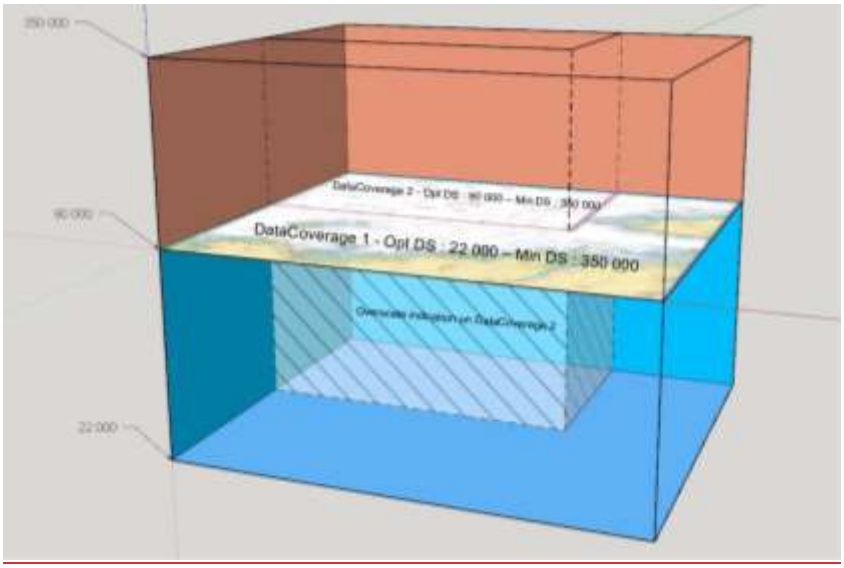


Figure 4-6 – Dataset with multiple Data Coverage features

- ~~The **Data Coverage** features within a dataset must not overlap, however Data Coverage features from different datasets may overlap if they have differing maximum display scales.~~

- ~~Datasets may overlap, however there must be no overlapping **Data Coverage** features of the same **maximum display scale**, except at the agreed adjoining national data limits, where, if it is difficult to achieve a perfect join, a 5 metre overlapping buffer zone may be used; and for this situation, there must be no gaps in data.~~

- ~~When a dataset has multiple **Data Coverage** features, then the **minimum display scale** must be the same for all **Data Coverage** features within the dataset. The **maximum display scale** for multiple **Data Coverage** features within a dataset may be different.~~

- When a dataset has multiple **Data Coverage** features then the **maximum display scale** of the dataset must be equal to the largest **maximum display scale** of the **Data Coverage** feature.

- The **maximum display scale** is considered to be the equivalent of the compilation scale of the data.

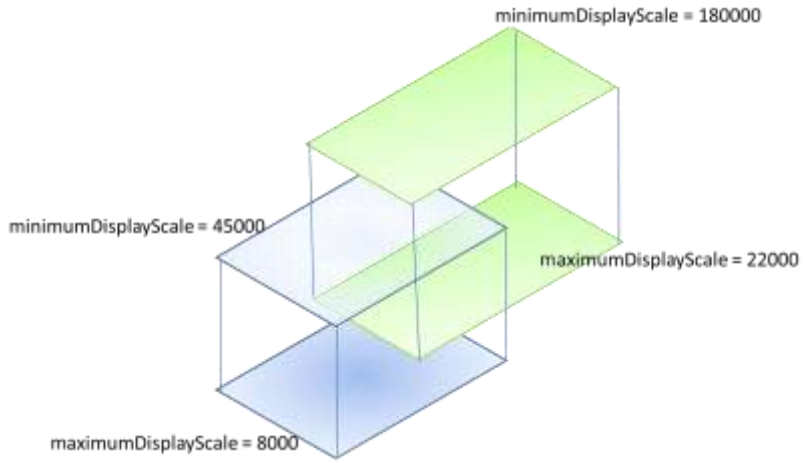


Figure 7 – Data Coverage Rules

4.5.4 Dataset size

Datasets must not exceed 10 MB.

Updates should not normally be larger than 1MB and must not be larger than 5 MB.

4.6 Display Scale Range

A scale range of a dataset is used to indicate a range of scales between which a producer considers the data is intended for use. (See clause 4.7 for how datasets are to be loaded and unloaded within a navigation system) The smallest scale is defined by the **minimum display scale** and the largest scale by the **maximum optimuim display scale**. The **maximum display scale** indicates the scale that the Data Producer considers that the "grossly overscaled" warning should be triggered. These scales must be set at one of the scales specified in clause 3 (spatial resolutions).

There must not be overlapping scale ranges (that is, overlaps between values of **optimum display scale** and **minimum display scale**) between datasets covering the same geographical area.

When the systems boatmaster's selected viewing scale (BSVS) is smaller than the value indicated by **minimum display scale**, features within the **Data Coverage** feature are not displayed, except where the the System DatabaseSENC does not contain a dataset covering the area at a smaller scale, in which case the dataset will be displayed at all smaller scales.

When the viewing scaleBSSVS is larger than the value indicated by **maximum optimum display scale**, the overscale indication, in the form of an overscale factor and pattern covering the area that is overscale, must be shown. When own vessel's position is covered by a dataset with a larger

Kommentiert [BB38]: Do we keep this for IENCs`

IEHG:keep

Kommentiert [BB39]: Seems to solve problems, if someone is just publishing one IENC or e.g. just an overview IENC of a whole region and 1 detailed IENC

IEHG: keep, but update the table nevertheless

Kommentiert [BB40]: Do we use the MSVS (Mariner's selected viewing scale) of S-101 or do we use BSVS (because we decided to use boatmaster instead of skipper)

COMEX2: BSVS, BSCS
Change pictures after approval of IEHG
(Acronym is not used in DCEG)
IEHG yes

~~maximum~~ **optimum display scale** than the BSSVCS is available~~t the skipper's selected viewing scale (SSVS),~~ an indication is required and should be shown on the same screen as the chart display.

When the MSSVS is larger than the value indicated by **maximum display scale**, the overscale indication, in the form of an overscale factor and, additionally, a pattern covering the area that is overscale, must be shown to indicate that the data is "grossly overscaled".

Within IENC schemes it is preferable that the scale ranges for different datasets covering the same geographical area to be continuous (see clause 4.5.3). However, where the scale ranges are non-continuous, the IECDIS will display the larger scale dataset until the BSSVS is equal to or at smaller scale than the ~~**maximum**~~**optimum display scale** of the next smaller scale dataset**.**

4.7 Dataset ~~l~~Loading and ~~d~~Display ~~o~~Order

NA ~~n~~ew algorithms for datasets loading and unloading, ande rendering (display) ~~based on producer defined dataset display scales (minimum and maximum) for dataset loading and unloading~~ within a navigation system are~~is~~ prescribed in S-401 in order for the appropriate IENC to be viewed at the skipper's selected viewing scale. This will simplify the process for the Inland ECDIS or ECS, giving clear and concise rules on how and when data is loaded and unloaded; and the order at which datasets are to be displayed. The concept of navigation purpose is restricted for use in presenting IENCs in a visual catalogue and must not be used for determining with dataset should be displayed.

Details of the dataset loading and data display algorithms are available in S-403~~98~~ Annex C. Appendix C-5 – *Dataset Loading Algorithm (Dataset Selection) and Dataset Display Order (Dataset Rendering).*

Note 1: The algorithms only address loading and display related to visualization within the system graphics window. The application may need to load other datasets to satisfy requirements related to alerts processing, such as MSC.232(82) A11.2.

Note 2: Light sectors. It should be possible, on request, for the mariner to be capable of identifying the colour of the sectors affecting the ship, even if the lights involved are off the display.

4.7.1 Dataset ~~l~~Loading ~~a~~Algorithm (dataset selection)

See S-403~~98~~ Annex C. Appendix C-5– *Dataset Loading Algorithm (Dataset Selection) and Dataset Display Order (Dataset Rendering).*

4.7.2 Dataset display order (dataset rendering)

See S-403~~98~~ Annex C, Appendix C-5 – *Dataset Loading Algorithm (Dataset Selection) and Dataset Display Order (Dataset Rendering)* (in development).

Figures 4-7 to 4-10~~9~~ below are intended to assist in understanding how the datasets should be displayed in the system graphics window:

Kommentiert [GM41]: S98 - Interoperability! Needs to be checked when there is a solution for this issue!

Kommentiert [GM42]: S98 - Interoperability! Needs to be checked when there is a solution for this issue!

Kommentiert [GM43]: S98 - Interoperability! Needs to be checked when there is a solution for this issue!

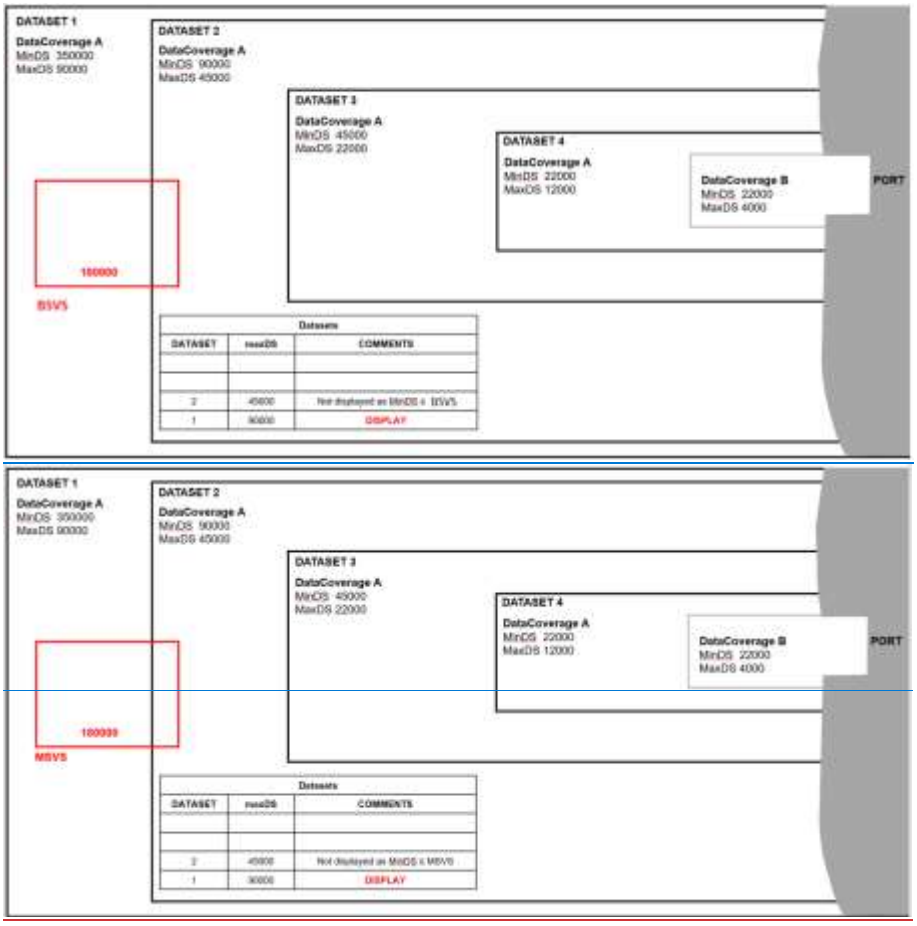


Figure 4-7 – Dataset loading – scenario 1

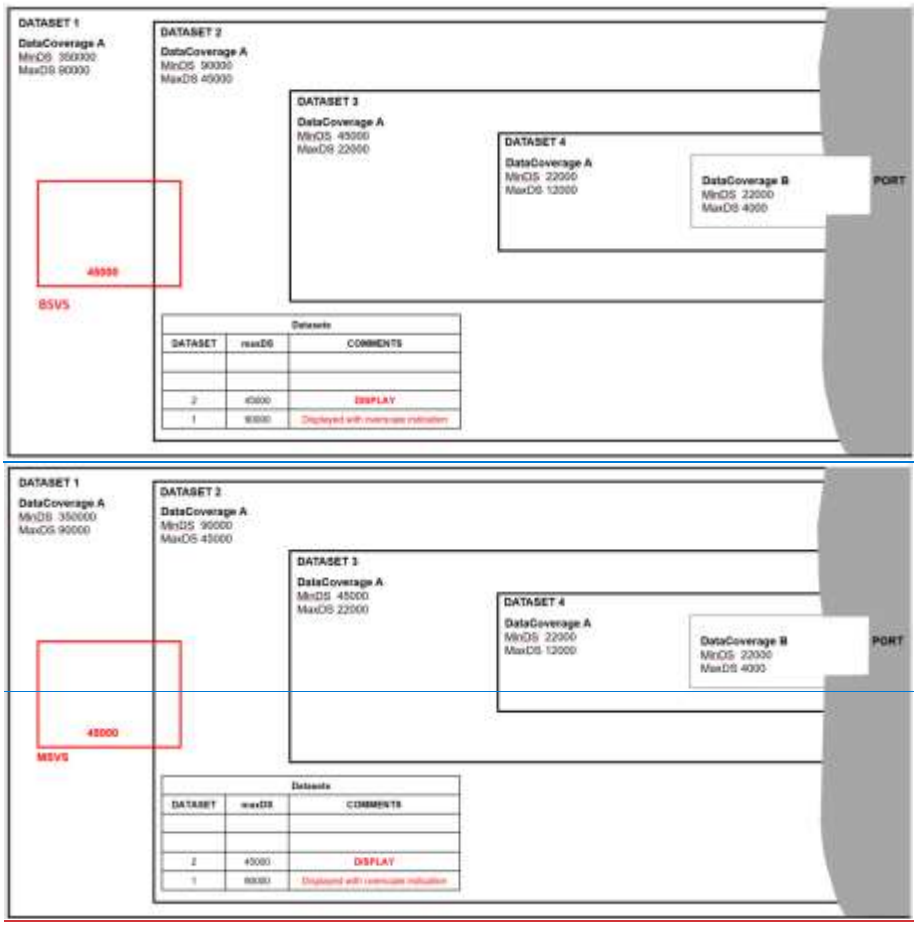


Figure 4-8 – Dataset loading – scenario 2

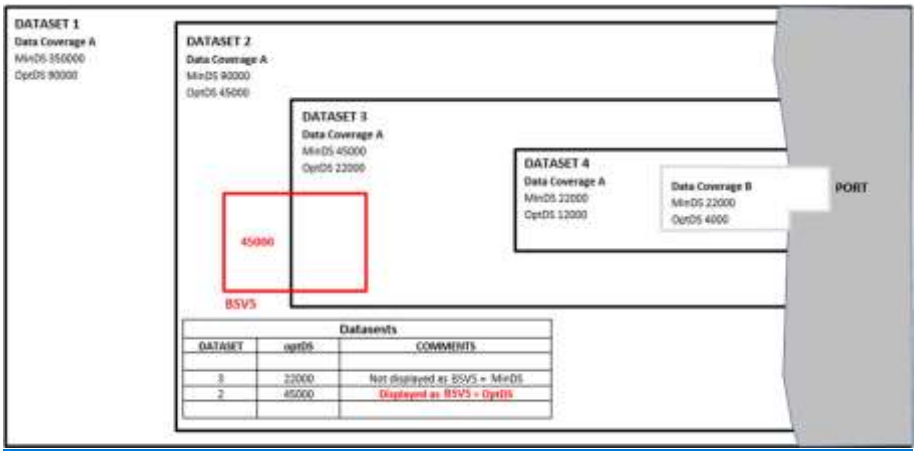


Figure 4-9 – Dataset loading – scenario 3

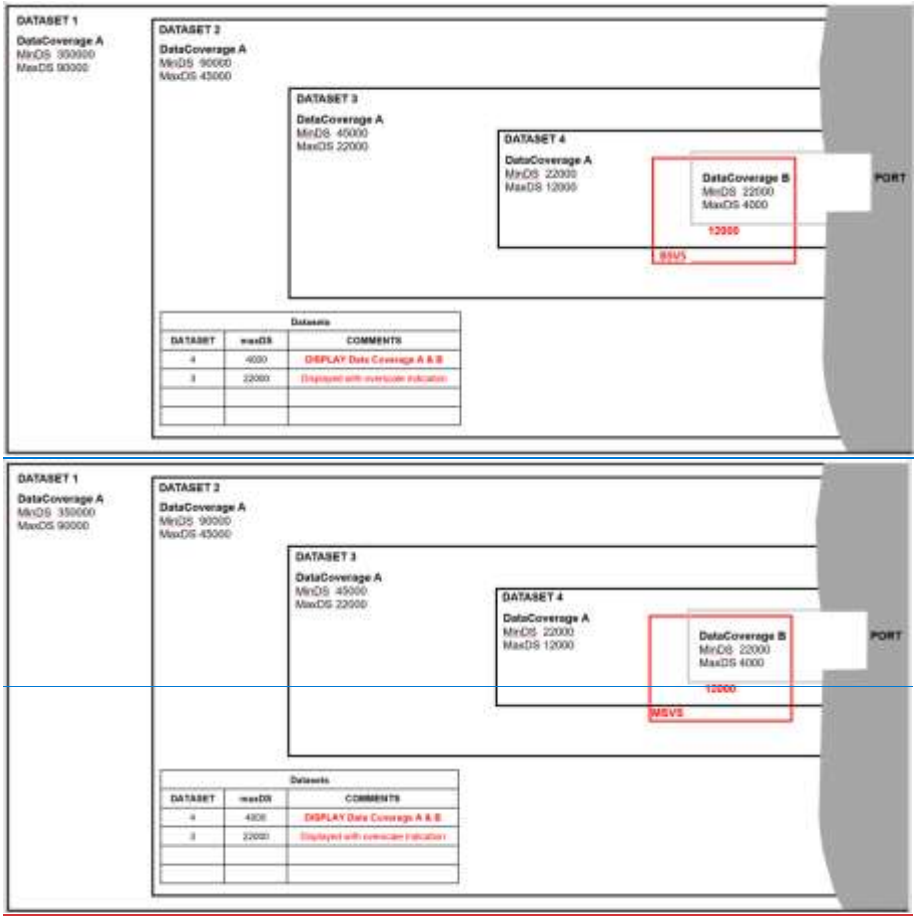
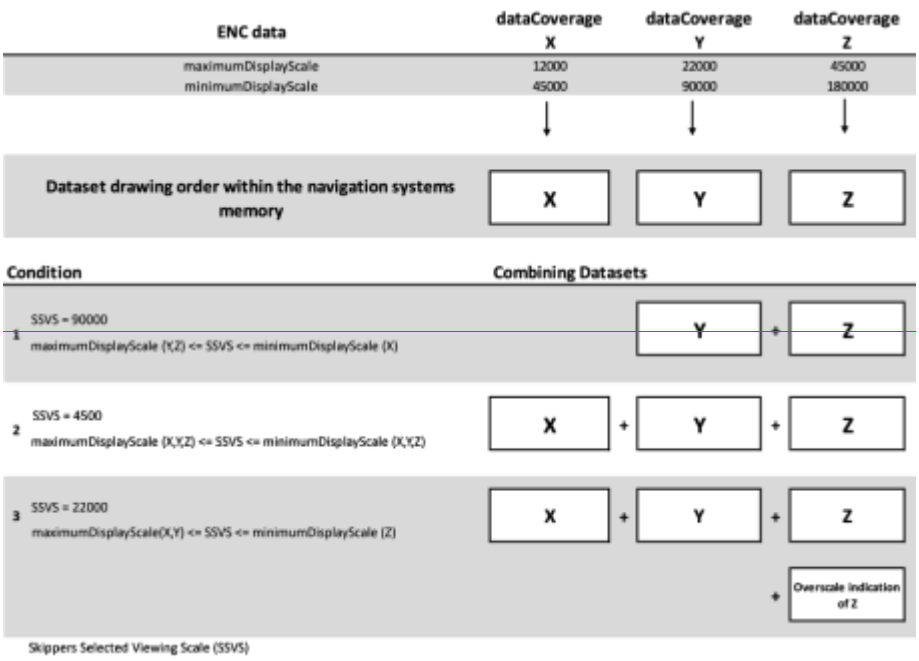


Figure 4-10 – Dataset loading – scenario 43

~~This clause defines the dataset loading and unloading algorithm for use within navigation systems.~~

~~In order for systems to properly load and unload data as the skipper is zooming in and out using the skipper's selected viewing scale (SSVS) the following algorithm must be used.~~



~~Figure 8 - Data Loading Algorithm~~

~~1. Create selection List~~

~~a. All **Data Coverage** areas within the graphics window within scale range (covered by the SSVS) are firstly ordered by **maximum display scale** and secondly by the largest percentage of coverage if **Data Coverage** areas have the same **maximum display scale**~~

~~b. All other smaller scale **Data Coverage** areas within the graphics window are firstly ordered by **maximum display scale** and secondly by the largest percentage of coverage if **Data Coverage** areas have the same **maximum display scale**~~

~~c. The display order is from the smallest **maximum display scale** to the largest **maximum display scale**, that is the **Data Coverage** area with largest **maximum display scale** will be displayed with the highest priority~~

~~d. If adjacent data coverages have the same **maximum display scale** they should be drawn so that all features of a given display priority from the adjacent data coverages are drawn prior to drawing features of the next display priority~~

~~2. If the SSVS is larger than the **maximum display scale** of an area within the window, turn on overscale indication.~~

~~3. If the skipper selects an individual dataset to load it must be displayed at its **maximum display scale**, that is SSVS is set to the **maximum display scale** of the selected dataset, and then the algorithm is used to fill the graphics window.~~

The example below works through four scenarios and uses four different types of **Data Coverage** with different **maximum display scale** and **minimum display scale**. They are denoted as areas A, B, C and D.

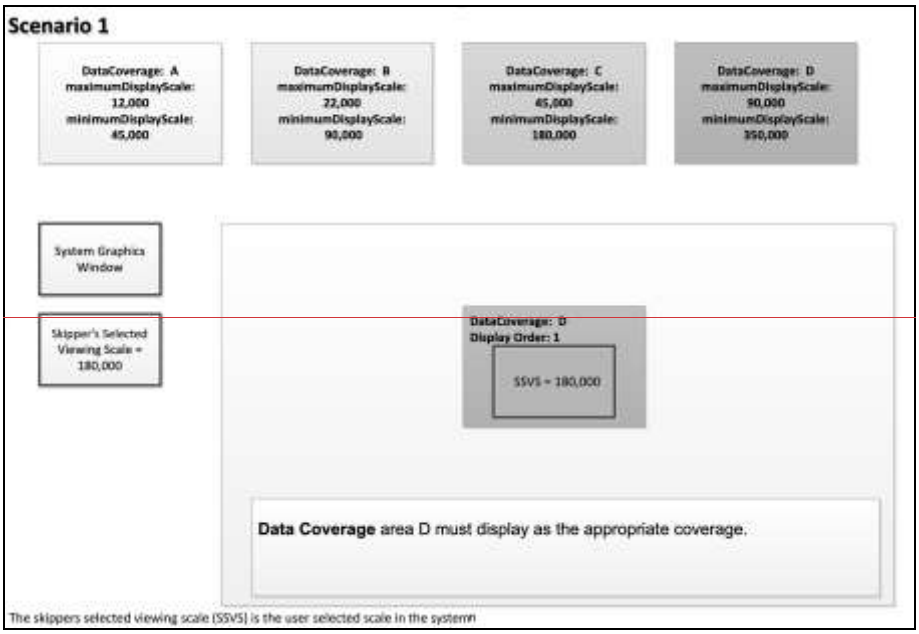


Figure 9 – Scenario 1: Simple Data Coverage Display

19

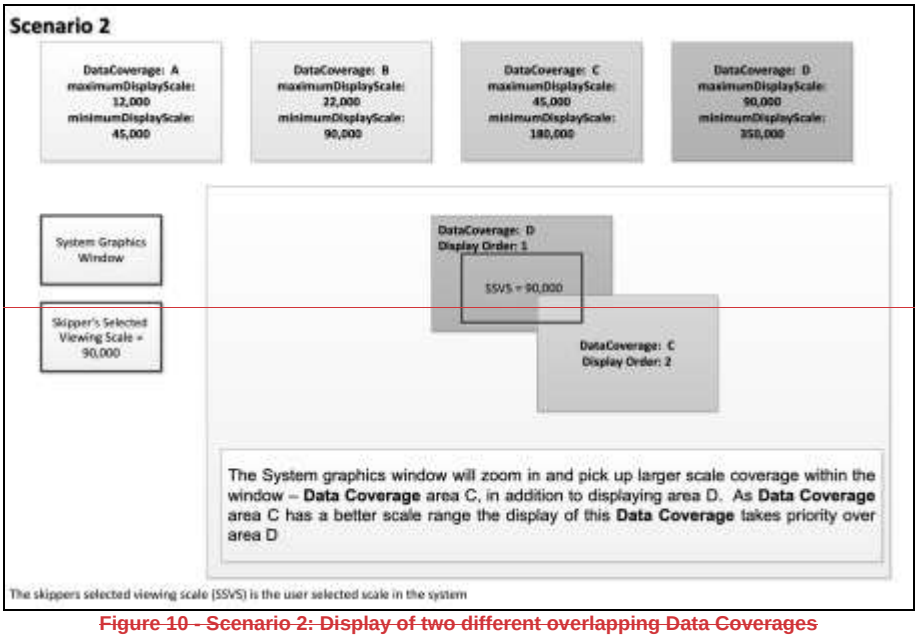


Figure 10 - Scenario 2: Display of two different overlapping Data Coverages

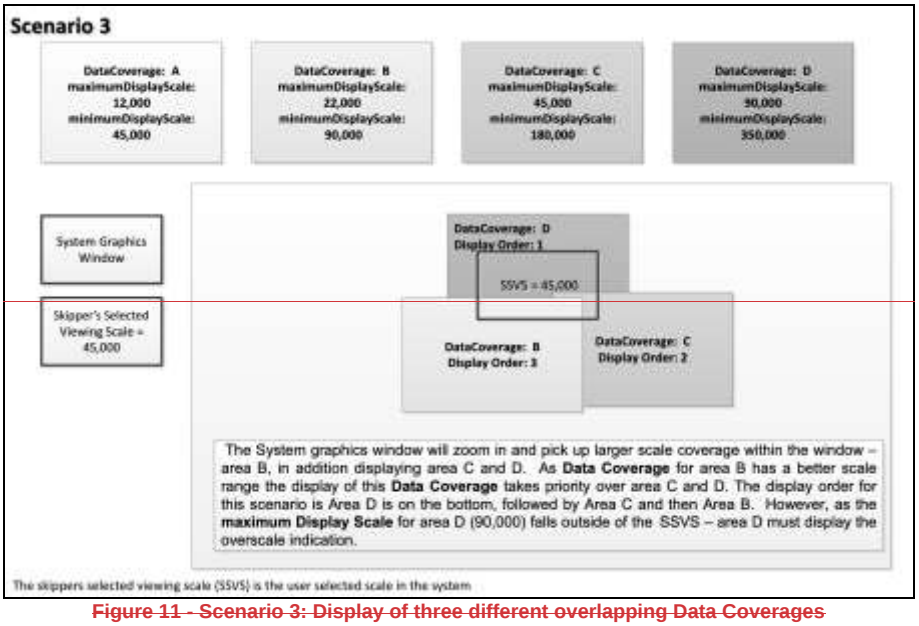
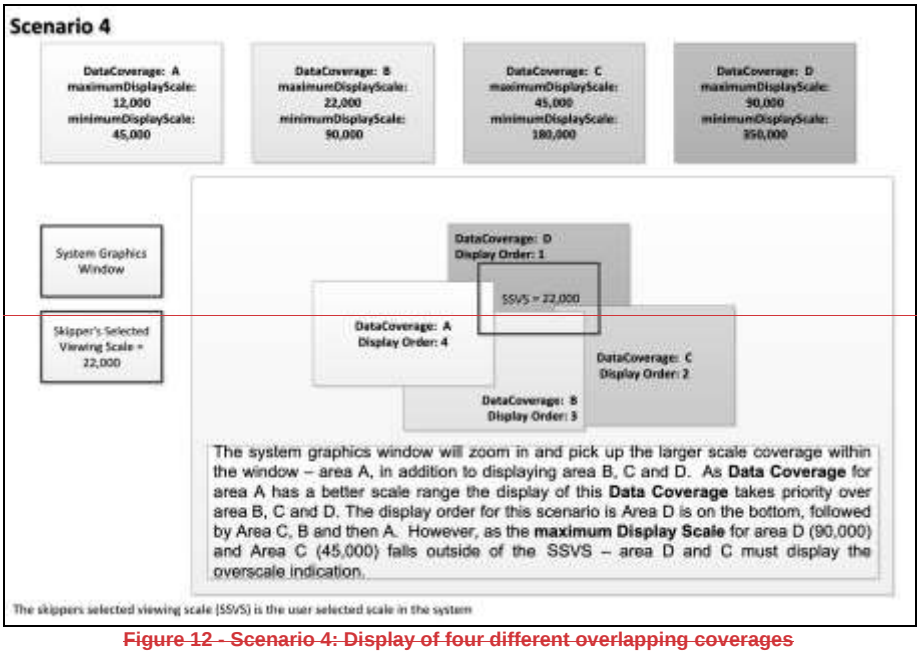


Figure 11 - Scenario 3: Display of three different overlapping Data Coverages



~~Figure 12 - Scenario 4: Display of four different overlapping coverages~~

4.8 Geometry

4.8.1 S-100 Level 3a Geometry

The underlying geometry of an IENC is constrained to level 3a which supports 0, 1 and 2 dimensional features (points, curves and surfaces) as defined by S-100 Part 7 – Spatial Schema.

Level 3a is described by the following constraints:

- Each curve must reference a start and end point (they may be the same).
- Curves must not self intersect. See Figure ~~13~~4-11.
- Areas are represented by a closed loop of curves beginning and ending at a common point.
- In the case of areas with holes, all internal boundaries must be completely contained within the external boundary and the internal boundaries must not intersect each other or the external boundary. Internal boundaries may touch other internal boundaries or the external boundary tangentially (That is at one point) as shown in Figure ~~14~~4-12.
- The outer boundary of a surface must be in a clockwise direction (surface to the right of the curve) and the curve orientation positive. The inner boundary of a surface must be in a counter-clockwise direction (surface to the right of the curve) and the curve orientation negative. See Figure ~~15~~4-13.

S-401 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 the maximum display scale.
- A feature may reference multiple geometries but must only reference geometries of a single geometric primitive (point, pointset, curve or surface).

The following exception applies to S-401:

- The use of coordinates is restricted to two dimensions, except in the case of soundings which use GM_Point or GM_Multipoint with three dimensional coordinates.

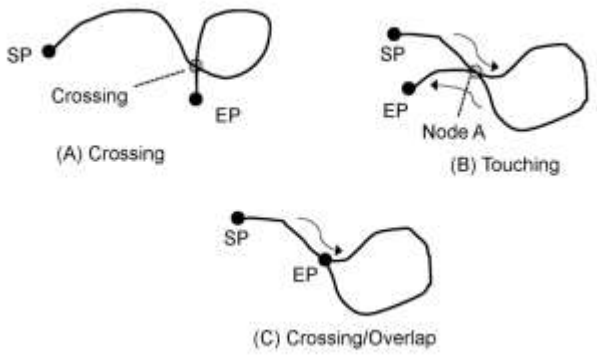


Figure 4-110513 - Self Intersect Example

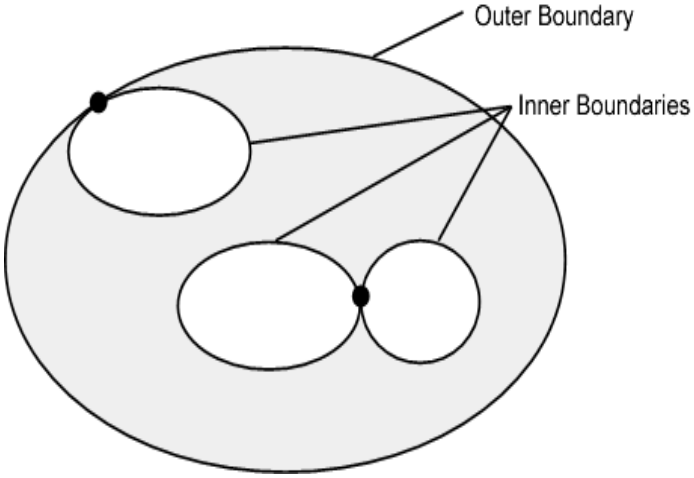


Figure ~~14~~ ~~4-1~~21~~ - Area Holes**

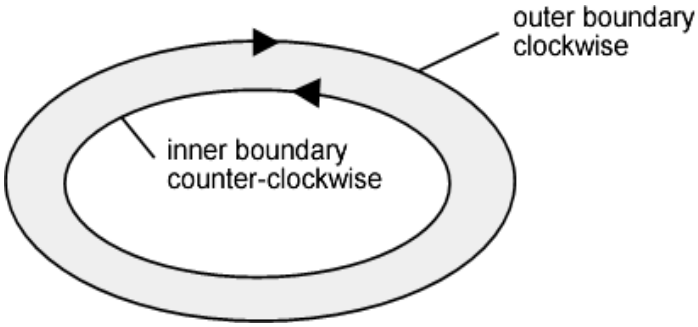


Figure ~~15~~ ~~4-1~~32~~ - Boundary Direction**

4.8.2 Use of scale properties for feature to geometry relations

The attributes *scaleMinimum* and *scaleMaximum* of class S100_GF_SpatialAttributeType are not used. Therefore, the encoding must always encode the values 'Not Applicable'.

Scale dependent depiction for the end user system is controlled by the thematic attribute **scale minimum** for the feature type only.

~~4.8.2~~4.8.3 Masking

In certain circumstances, the symbolization of a curve may need to be suppressed. This is done using the Masked Spatial Type [MASK] field of the Feature Type record. The Mask Update Instruction [MUIN] must be set to {1} and Referenced Record name [RRNM] and Referenced Record identifier [RRID] fields must be populated with the values of the referenced spatial record. The Mask Indicator [MIND] must be set to either {1} or {2} (see Annex B – clause B.5.1.33)

Figure ~~16~~ 4-14 is an example without masking and Figure ~~17~~ 4-15 is an example of a masked edge between **River** and **Depth Area** features, where the River should be masked. In this example MIND is set to {2} – supress portrayal.

Figure ~~4-1416~~ - Example without masking

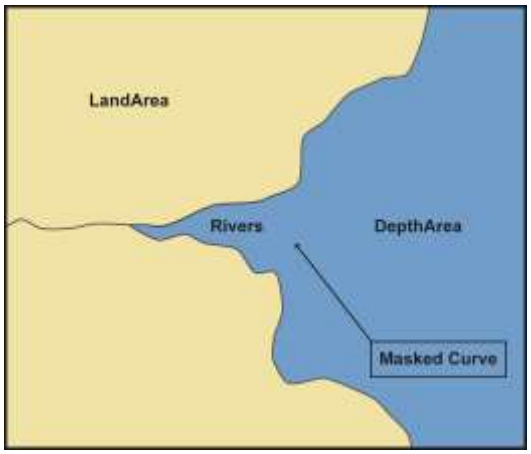


Figure 17-4-15 - Example with masking

5 Coordinate Reference Systems (CRS)

5.1 Introduction

An IENC dataset must define at least one compound CRS, which must be composed of one geodetic CRS and one vertical CRS. All compound CRSs within the same dataset must use the same geodetic CRS.

NOTE: The vertical CRS described in clause 5.3 below does not apply to depths, heights, elevations and vertical clearances where the information is encoded as an attribute rather than the vertical component (Z-coordinate) of the CRS. This vertical datum information is included in the IENC dataset using the meta features **Sounding Datum** and **Vertical Datum of Data**. See S-4101 Annex A – *Data Classification and Encoding Guide* clauses 3.9 and 3.10.

5.2 Horizontal Coordinate Reference System

For IENC the horizontal CRS must be EPSG:4326 (WGS84). The full reference to EPSG: 4326 can be found at www.epsg-registry.org.

Horizontal coordinate reference system:	EPSG:4326 (WGS84)
Projection:	None
Temporal reference system:	Gregorian calendar
Coordinate reference system registry:	EPSG Geodetic Parameter Registry
Date type (according to ISO 19115):	002- publication
Responsible party:	International Organisation of Oil and Gas Producers (IOGP)
URL:	https://www.iogp.org

5.3 Vertical CRS for Soundings

For IENC the vertical CRS must be in metres and is only relevant to soundings (S-4101 features **Sounding** and ~~**Depth – No Bottom Found**~~, see S-4101 Annex A – *Data Classification and Encoding Guide* clause 3.9), where the depth information is stored in the Z-coordinate. Depths are represented by positive values, while negative values indicated intertidal (drying) soundings.

Although all coordinates in a dataset must refer to the same geodetic 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.

The encoding of the Coordinate Reference System record fields can be found at Annex B, clauses B-5.1.9 to B-5.1.12; and is ~~will~~ be demonstrated with the following examples. The example at Table 5-1 ~~The first example~~ specifies a compound CRS. The first component of the first example is a 2D Geographic CRS (WGS84). The second component of the first example is a Vertical CRS for depth using the Vertical Datum: Mean High Water.

Kommentiert [BB44]: To be checked

Kommentiert [GM45]: In S-101 PS edition 1.4.1: Lowest Astronomical Tide

IEHG: keep

Table 5-1 – Compound CRS (WGS84 and mean high water~~d Lowest Astronomical Tide~~)

Field	Subfield	Value	Description
CSID			**Coordinate Reference System Record Identifier**
	RCNM	15	Record Name (15 = Coordinate Reference System Identifier)
	RCID	1	Record Identification Number
	NCRC	2	Number of CRS Components
CRSH			**Coordinate Reference System Header**
	CRIX	1	CRS Index
	CRST	1	CRS Type (1 = 2D Geographic)
	CSTY	1	Coordinate System Type (1 = Ellipsoidal CS)
	CRNM	WGS84	CRS Name
	CRSI	4326	CRS Identifier
	CRSS	2	CRS Source (2 = EPSG)
	SCRI		CRS Source Information (omitted)
CRSH			**Coordinate Reference System Header**
	CRIX	2	CRS Index
	CRST	5	CRS Type (5 = Vertical)
	CSTY	3	Coordinate System Type (3 = Vertical)
	CRNM	Depth - mean high water	CRS Name
	CRSI		CRS Identifier (omitted)
	CRSS	255	CRS Source (255 = Not Applicable)
	SCRI		CRS Source Information (omitted)
CSAX			**Coordinate System Axes**
	AXTY	12	Axis Type (12 = Gravity Related Depth)
	AXUM	4	Axis Unit of Measure (4 = Metres)
VDAT			**Vertical Datum**
	DTNM	mean high water	Datum Name
	DTID	16	Datum Identifier (16 = Mean High Water)
	DTSR	2	Datum Source (2 = Feature Catalogue)
	SCRI		Datum Source Information (omitted)

The example at Table 5-2 ~~The second example~~ is similar to the ~~first~~ above except that its second component is encoded with the Vertical Datum: Mean Sea Level.

Table 5-2 – Compound CRS (WGS84 and Mean Sea Level)

Field	Subfield	Value	Description

CSID			**Coordinate Reference System Record Identifier**
	RCNM	15	Record Name (15 = Coordinate Reference System Identifier)
	RCID	1	Record Identification Number
	NCRC	2	Number of CRS Components
CRSH			**Coordinate Reference System Header**
	CRIX	1	CRS Index
	CRST	1	CRS Type (1 = 2D Geographic)
	CSTY	1	Coordinate System Type (1 = Ellipsoidal CS)
	CRNM	WGS84	CRS Name
	CRSI	4326	CRS Identifier
	CRSS	2	CRS Source (2 = EPSG)
	SCRI		CRS Source Information (omitted)
CRSH			**Coordinate Reference System Header**
	CRIX	2	CRS Index
	CRST	5	CRS Type (5 = Vertical)
	CSTY	3	Coordinate System Type (3 = Vertical)
	CRNM	Depth - mean sea level	CRS Name
	CRSI		CRS Identifier (omitted)
	CRSS	255	CRS Source (255 = Not Applicabel)
	SCRI		CRS Source Information (omitted)
CSAX			**Coordinate System Axes**
	AXTY	12	Axis Type (12 = Gravity Related Depth)
	AXUM	4	Axis Unit of Measure (4 = Metres)
VDAT			**Vertical Datum**
	DTNM	mean sea level	Datum Name
	DTID	3	Datum Identifier (3 = Mean Sea Level)
	DTSR	2	Datum Source (2 = Feature Catalogue)
	SCRI		Datum Source Information (omitted)

NOTE: For S-4101, the vertical CRS encoded in the Coordinate Reference System record fields for soundings is not utilized by the Inland ECDIS or ECS in conveying the sounding datum information for an IENC to the boatmasterMariner in Inland ECDIS or ECS. This information is provided instead using the S-4101 meta feature **Sounding Datum** (see S-4101 Annex A – *Data Classification and Encoding Guide*, clause 3.9).

6 Data Quality

6.1 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-401 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;
- Depth Uncertainty and Accuracy;
- Positional Uncertainty and Accuracy;
- Thematic Accuracy;
- Temporal Quality;

- Aggregation measures;
- Validation checks or conformance checks including:
    - General tests for dataset integrity;
    - Specific tests for compliance against the S-401 data model.

In addition to conformance to the Data Quality elements detailed in clause 6.2 below, additional quantitative information may be provided to the user using relevant metadata features and attribution. The hierarchy of metadata provided in S-401 Annex A – *Data Classification and Encoding Guide* at Table 3-1 in clause 3.3 describes this further. For S-401 it is not relevant to provide a Data Quality Report to end users.

~~For S-401 data quality is divided into two parts – data compliance, usability and integrity against all requirements of S-401; and bathymetric data quality.~~

6.2 Completeness

6.2.1 Commission

Commission is applicable for S-401. Data Producers must verify that no excess items have been included in the dataset. This includes duplicate items, which must be removed.

S-401 Annex C – *S-401 Validation Checks*, includes data validation check(s) intended to identify excess and/or duplicate items.

If no excess or duplicate items are present the dataset PASSES this test.

6.2.2 Omission

Omission is applicable for S-401. Data Producers must verify that no items that should have been included in the dataset have been missed. This includes missing features specified as mandatory in S-101; and missing support files referenced by the dataset.

S-401 Annex C – *S-401 Validation Checks*, includes data validation check(s) intended to detect missing items.

If no items have been omitted the dataset PASSES this test.

6.3 Logical consistency

6.3.1 Conceptual consistency

Conceptual Consistency is applicable for S-401 and follows the guidelines from S-100 Part 1.

Data Producers must verify that the dataset conforms to the S-100 General Feature Model. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no conceptual consistency checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.3.2 Domain consistency

Domain consistency is applicable for S-401 and follows the guidelines from S-100 Part 5.

Data Producers must verify that the dataset conforms to the S-401 Feature Catalogue and rules described in the S-401 Annex A – *Data Classification and Encoding Guide*. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no domain consistency checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.3.3 Format consistency

Format Consistency is applicable for S-401 and follows the guidelines from S-100 Part 10a.

Data Producers must verify that the dataset conforms to S-401 Annex B – *Data Product format (encoding)*. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no format consistency checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.3.4 Topological consistency

Topological consistency is applicable for S-401 and follows the guidelines from S-100 Part 7.

Data Producers must verify that the dataset conforms to the requirements for topology set out in Section 4 of this document. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no topological consistency checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.4 Positional uncertainty and accuracy

6.4.1 Absolute or external accuracy

Absolute or external accuracy is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify the absolute accuracy of S-401 datasets and ensure that they achieve an adequate accuracy. Additionally the relevant metadata features and attributes as described in S-401 Annex A – *Data Classification and Encoding Guide*, must be populated where applicable.

6.4.2 Vertical position accuracy

Vertical position accuracy is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify the vertical position accuracy of S-401 datasets and ensure that they achieve an adequate accuracy. The relevant metadata features and attributes as described in S-401 Annex A – *Data Classification and Encoding Guide*, should be populated to reflect the vertical position accuracy.

6.4.3 Horizontal position accuracy

Horizontal position accuracy is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify the horizontal position accuracy of S-401 datasets and ensure that they achieve an adequate accuracy. The relevant metadata features and attributes as described in S-401 Annex A – *Data Classification and Encoding Guide*, should be populated to reflect the horizontal position accuracy.

6.4.4 Relative or internal accuracy

Relative or internal accuracy is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify the relative or internal accuracy of S-401 datasets and ensure that they achieve an adequate accuracy.

6.4.5 Gridded data positional accuracy

Gridded data positional accuracy is not applicable for S-401.

6.5 Thematic accuracy

6.5.1 Thematic classification correctness

Thematic classification correctness is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify that features have been encoded correctly when included in the S-401 dataset. Encoded features must conform to the S-401 Feature Catalogue and the rules described in

the S-401 Annex A – *Data Classification and Encoding Guide*. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no thematic classification correctness checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.5.2 Non-quantitative attribute accuracy

Non-quantitative attribute accuracy is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify that non-quantitative attributes have been populated correctly when included in the S-401 dataset. Non-quantitative attributes must conform to the S-401 Feature Catalogue and the rules described in the S-401 Annex A – *Data Classification and Encoding Guide*. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no non-quantitative attribute checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.5.3 Quantitative attribute accuracy

Quantitative attribute accuracy is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify that quantitative attributes have been populated correctly when included in the S-401 dataset. Quantitative attributes must conform to the S-401 Feature Catalogue and the rules described in the S-401 Annex A – *Data Classification and Encoding Guide*. Relevant metadata features and attributes must be used to indicate the accuracy where applicable. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no quantitative attribute checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.6 Temporal quality

6.6.1 Temporal consistency

Temporal consistency is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify that the dataset conforms to rules described in the S-401 Annex A – *Data Classification and Encoding Guide*. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no temporal consistency checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.6.2 Temporal validity

Temporal validity is applicable for S-401 and follows the guidelines from S-100 Part 4c.

Data Producers must verify that the dataset conforms to rules described in the S-401 Annex A – *Data Classification and Encoding Guide*. S-401 Annex C – *S-401 Validation Checks*, provides validation checks which verify this conformance.

If no temporal validity checks classified as Critical in S-401 Annex C are reported the dataset PASSES this test.

6.6.3 Temporal accuracy

Temporal accuracy is applicable for S-401 and follows the guidelines from S-100 Part 4c.

The Data Producer must verify the temporal accuracy of the S-401 dataset.

6.7 Aggregation

Aggregation is applicable for S-401. The aggregated data quality result provides a result if the dataset has passed conformance to the Product Specification.

The competent Data Producers~~authorities~~~~Data Producers~~ must ensure that all applicable data quality aspects are checked and only if all of these checks are PASSED can the dataset be considered a valid S-401 dataset. This is indicated by the Data Producer signing the dataset.

Kommentiert [BB46]: How is an IENC "signed"?
IEHG: has to be checked
Replace Data Producer with competent authority

Tools will allow to sign a dataset (see minutes of 18th IEHG meeting)

IEHG keep data producer, because also private producers have to sign

~~6.2~~6.8 Data Compliance and Usability

All S-401 datasets must be validated against the above data quality elements using conformance checks that are located in Annex C – IENC Validation Checks. As a minimum requirement, all datasets must conform to all checks that are categorized as "Critical" in Annex C.

S-401 datasets must conform to all mandatory elements of Annex A – Encoding Guide, where the word 'must' is used.

In addition to the above, dataset usability must be assessed against:

- Intended user requirements in regard to coverage, scale and specific content requirements as defined by the Producing Agency and key stakeholders;
- Conformance to established maintenance processes (see Section 8); and
- Overall compliance with the S-401 Product Specification, including context-specific evaluation of individual encoding instances for requirement of conformance to checks classified as "Error" and "Warning" in Annex C – IENC Validation Checks.

For dataset integrity requirements, see clause 11.6.

~~**6.2.1 Bathymetric Data Quality**~~

~~Bathymetric data quality comprises the following:~~

~~— completeness of data (For example, waterway coverage).~~
~~— currency of data (For example, temporal degradation);~~
~~— uncertainty of data;~~
~~— source of data;~~

~~Data quality can be encoded at three different metadata levels (dataset, feature, feature instance).All positional (2D), vertical (1D), horizontal distance (1D) and orientation (1D) uncertainty attributes concern the 95% confidence level of the variation associated with all sources of measurement, processing and visualization error. Uncertainty due to temporal variation should not be included in these attributes.~~

~~The meta feature for Bathymetric data quality is: **Quality Of Bathymetric Data**.~~

~~**6.2.2 Non Bathymetric Data Quality**~~

~~The meta feature **Quality Of Nonbathymetric Data** allows for data quality to be expressed for non bathymetric items.~~

~~**6.2.3 Survey Data Quality**~~

~~Quality of the surveys that originated from which charted features are derived can be further expressed using the meta feature **Quality Of Survey**. **Quality Of Survey** can apply to bathymetry (For example, underwater rock), non bathymetry (For example, navigational aids) and a combination of these (For example, lidar survey).~~

7 Data Capture and Classification

7.1 Introduction

The S-401 IENC Encoding Guide (DCEG) for Inland ENCs describes how data describing the real world should be captured using the types defined in the S-401 Feature Catalogue. This Guide is located in Annex A.

8 Maintenance

8.1 Introduction

This clause describes the requirements to adequately maintain datasets; use of newly acquired source data; maintenance requirements within the overall production process; and how Feature and Portrayal Catalogues are to be managed within an S-100 system.

8.2 Maintenance and Update Frequency

Datasets must be maintained as needed; and the overall production process must include mechanisms for IENC updating designed to meet the needs of the skipper regarding safety of navigation.

8.3 Data Source

Data Producers must use all available and applicable sources, as evaluated against a robust data assessment process to maintain and update IENC datasets as required.

8.4 Production Process

Data Producers should follow their established production processes for maintaining and updating datasets. Data is produced against ~~the~~ S-401 Annex A – *Data Classification and Encoding Guide* ~~for Inland ENCs~~, checked against S-401 Annex C – *IENC* ~~*Recommended*~~ *Validation Checks* ~~for Inland ENCs~~ and encapsulated in ISO/IEC 8211.

Only maintained datasets that conform to the mandatory requirements outlined in S-401 will be considered an IENC.

8.5 Feature and Portrayal Catalogue Management

For each new version of the S-401 Product Specification a new Ffeature and/or Pportrayal catalogue will be released. The management of Feature and Portrayal Catalogues in end user systems is described in ~~IHO Publication S-~~403~~98~~ – *Data Product Interoperability in S-100 Navigation Systems*. ~~The end user system must be able to manage datasets and their catalogues that are created on different versions of the S-401 product specification.~~

~~NOTE: During the testing phase of S-401, two different types of catalogue options are being tested. Option 1 is to create a feature and portrayal catalogues that contain cumulative changes. Option 2 is that the system will maintain multiple catalogues, where each catalogue is tied to a specific version of S-401.~~

Kommentiert [BB47]: Might have to be updated

9 Portrayal

9.1 Introduction

S-401 portrayal is intended to contribute to the safe operation of an S-100 based navigation system by:

- Ensuring a base and supplementary levels of display for IENC data; standards of symbols, colours and their standardized assignment to features; ~~scale limitations of data presentation; and appropriate compatibility with paper chart symbols as standardized in the Chart Specifications of the IHO (IHO Publication S-4);~~
- Ensuring the display is clear and unambiguous,
- Eestablishing an accepted pattern for presentation that becomes familiar to skippers and so can be recognized instantly without confusion; and~~,~~
- Uutilizing the S-100 portrayal model to ensure interoperability.

To ensure that presentation remains intuitive, including where S-401 IENCs are used in conjunction with S-57 IENCs, the following principles must be followed when changes are made to the S-401 Portrayal Catalogue:

- ~~S-401 may extend the Portrayal Catalogue with new symbols, however they must follow IHO Publication S-4 - *Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO*, including conventions on colour; and be designed to be intuitive to the user;~~
- S-401 may modify existing symbols, however key aspects such as shape and colour should be retained in order to ensure that the symbol remains identifiable;
- S-401 must maintain equivalence in terms of alerts and indications functionality in Inland ECDIS or ECS;
- The S-401 Portrayal Catalogue should be modified by extension. Symbols and Portrayal rules should be retained for items that have been superseded in the current version of S-401. This ensures that S-401 data produced to previous versions can be displayed using the latest Portrayal Catalogue.

S-401 portrayal is covered by the portrayal model as defined in S-100. This model reflects how the Pportrayal Ccatalogue is defined for use in navigation systems. The Pportrayal Ccatalogue defines symbology and the portrayal rules for each feature/~~-~~attribute combination contained in the Ffeature Ccatalogue.

S-401 uses the portrayal process defined in S-100 Part 9A.

Items included in an S-401 Portrayal Catalogue must be registered in the IHO Geospatial Information (GI) Registry.

9.2 Portrayal Catalogue

Citation information for the Portrayal Catalogue is provided in Table 9-1~~-5~~ below.

Table 9-1 – S-401 Portrayal Catalogue

No.	ISO class or attribute	Type	Value
--	CI_Citation	Class	--
1	title	CharacterString	S-401 Portrayal Catalogue
2	date	CI_Date (class)	--
2.1	date	DateTime	202518-12-31T00:00:00
2.2	dateType	CI_DateTypeCode (ISO codelist)	publication

Kommentiert [BB48]: Is this sentence useful for S-401? Delete it or clarify that it just explains sources

IEHG: delete

Kommentiert [BB49]: Not applicable for IENCs Delete or amend?

IEHG: delete

Kommentiert [BB50]: To be updated

3	edition	CharacterString	1.20.0
4	editionDate	DateTime	202518-12-31T00:00:00
5	citedResponsibleParty	CI_Responsibility (class)	--
5.1	role	CI_RoleCode (ISO codelist)	publisher
5.2	party	CI_Organisation (class)	--
5.2.1	name	CharacterString	IEHG
6	otherCitationDetails	CharacterString	(Replace with website navigation instructions, etc.. ISO 19115-1 defines this attribute as "other information required to complete the citation that is not recorded elsewhere.") https://ienc.openecdis.org?
7	onlineResource	CI_OnlineResource (class)	--
7.1	linkage	CharacterString (URL)	http://registry.iho.int
7.2	name	CharacterString	S-401 portrayal catalogue
7.3	description	CharacterString	XML portrayal catalogue accompanied by related files for symbols, colour profiles, rules, etc.

Table 5 – S-401 Portrayal Catalogue

Kommentiert [BB51]: To be updated

Kommentiert [BB52]: https://ienc.openecdis.org?

IEHG: yes, as an example

The Pportrayal Ccatalogue contains the mechanisms for the system to portray information found in S-401 IENCs. The S-401 P portrayal Ccatalogue contains the following types of mechanisms and structures:

- Set of portrayal rules
- Set of pixmaps, symbols, complex line styles, area filles, fonts and colour profiles

The portrayal catalogue model is defined in S-100 Part 9, clause 9-13.

Kommentiert [GM53]: Not sure. Check!

The S-401 Portrayal Catalogue will be available in an XML document which conforms to the S-100 XML Portrayal Catalogue Schema. The structure for the Portrayal Catalogue is described in S-100 Part 9, clause 9-13.2. and is structured as follows:

Root ---- (contains the catalogue named "**portrayal_catalogue.xml**")

—|

—|-- Pixmaps (contains XML files describing pixmaps)

—|

—|-- ColorProfiles (contains XML files with colour profiles and CSS2 style sheets)

—|

—|-- Symbols (contains SVG files with symbols)

—|

—|-- LineStyles (contains XML files with line styles)

~~—|~~

~~—|-- AreaFills (contains XML files area fills)~~

~~—|~~

~~—|-- Fonts (contains TrueType font files)~~

~~—|~~

~~—|-- Rules (contains files with rules which map features to drawing instructions)~~

10 Data Product format (encoding)

10.1 Introduction

This clause specifies the encoding for S-4101 datasets. See Annex B for a complete description of the data records, fields and subfields defined in the encoding.

Format Name: ISO/IEC 8211

Character Set: ISO 10646 Base Multilingual Plane

Specification: S-100 profile of ISO/IEC 8211 (part 10A)

10.1.1 Encoding of Latitude and Longitude

Coordinates are stored as integers. Latitude and longitude are converted to integers using a multiplication factor held in the Dataset Structure Information field under [CMFX] and [CMFY] (see Annex B – clause B1.6.3).

Kommentiert [BB54]: To be checked

These coordinate multiplication factors must be set to {10000000} (10^7) for all datasets.

EXAMPLE A longitude = 42.0000 is converted into X = longitude * CMFX = 42.0000 * 10000000 = 420000000.

10.1.2 Encoding of Depths as coordinates

Depths are converted from decimal metres to integers by means of the [CMFZ] (see Annex B – clause B1.6.3). This product limits the resolution to two decimal places and therefore the [CMFZ] must be set to {100}.

Kommentiert [BB55]: To be checked

EXAMPLE: A depth = 4.2 is converted in Z = depth*CMFZ = 4.2*10~~0~~ = 42~~0~~

10.1.3 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.

10.1.4 Text Attribute Values

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

10.1.5 Unknown Attribute Values

In a base dataset and an update dataset, when an attribute code is present but the attribute value is missing, it means that the producer wishes to indicate that this attribute value is unknown.

In an update dataset, when an attribute code is present but the attribute value is missing it means:

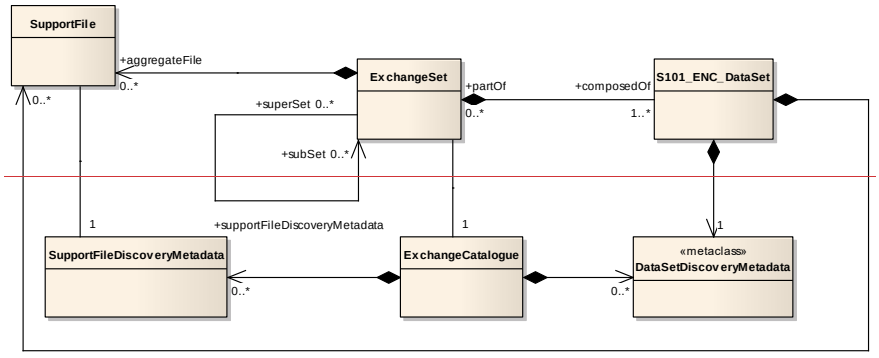
- that the value of this attribute is to be replaced by an empty (null) value if it was present in the original dataset; or
- that an empty (null) value is to be inserted if the attribute was not present in the original dataset.

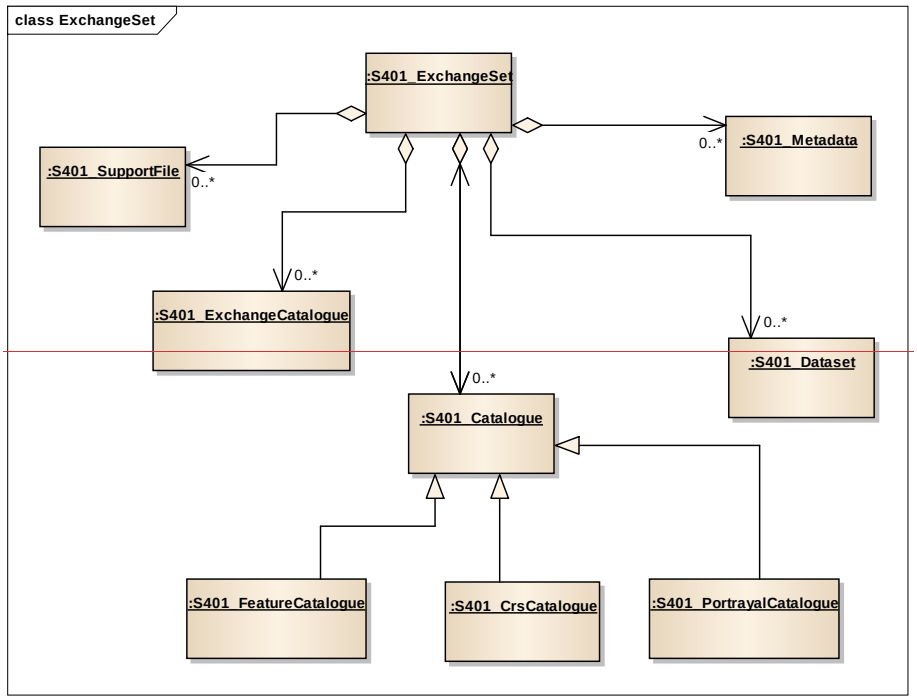
11 Data Product Delivery

11.1 Introduction

This clause specifies the encoding and delivery mechanisms for an S-401 IENC. Data which conforms to this product specification must be delivered by means of an exchange set.

The S-100 Exchange Set structure is described in S-100 Part 17, clause 17-4.1.





~~Figure 18 - Exchange Set Structure~~

11.2 Exchange Set

S-401 datasets are grouped into Eexchange Ssets. Each Eexchange Sset consists of one or more IENC datasets with ~~an associated XML metadata file and~~ a single Exchange Catalogue XML file containing metadata, an associated XML Metadata file (S100_ResourcePurpose (ISOMetadata) – see S-100 Part 17, clause 17-4.5) may be included (see clause 11.5). It may also include one or more support files. The S-401 Eexchange Sset structure is the same as that described in S-100 Part 17-4.1.

Units of Delivery: Exchange Set

Transfer Size: Unlimited

Medium Name: Digital data delivery

Other Delivery Information:

Each Exchange Set has a single Exchange Catalogue which contains the discovery metadata for each dataset and references to any support files. See S-100 Part 17, clauses 17-4.4 and 17-4.5.

~~Each dataset must be contained in a physically separate, uniquely identified file on the transfer medium.~~

~~Each exchange set has a single exchange catalogue which contains the discovery metadata for each dataset and references to any support files.~~

~~Support files are supplementary information which are linked to the features by the complex attribute **information**, sub-attribute **file reference**; and by the simple **pictorial representation**.~~

~~An exchange set is encapsulated into a form suitable for transmission by a mapping called an encoding. An encoding translates each of the elements of the exchange set into a logical form suitable for writing to media and for transmission online. An encoding may also define other elements in addition to the exchange set contents (This is media identification, data extents etc…) and also may define commercial constructs such as encryption and compression methods.~~

~~If the data is transformed in S-401 it must not be changed.~~

~~This product specification defines the encoding which must be used as a default for transmission of data between parties.~~

~~The encoding encapsulates exchange set elements as follows:~~

~~**11.2.1 Mandatory Elements**~~

- ~~**I**ENC datasets – ISO 8211 encoding of features/attributes and their associated geometry and metadata.~~

- ~~Exchange Catalogue – the XML encoded representation of exchange set catalogue features [discovery metadata].~~

~~**11.2.2 Optional Elements**~~

- ~~Supplementary files – These are contained within the exchange set as files and the map from the name included within the dataset and the physical location on the media is defined within the Exchange Catalogue.~~

- ~~S-401 Feature Catalogue – If it is necessary to deliver the latest feature catalogue to the end user it may be done using the S-401 exchange set mechanism for datasets~~

- ~~S-401 Portrayal Catalogue - If it is necessary to deliver the latest portrayal catalogue to the end user it may be done using the S-401 exchange set mechanism for datasets.~~

11.3 Dataset

11.3.1 Datasets

Four types of dataset files may be produced and contained within an exchange set:

- New dataset and new edition of a dataset (base dataset): Including 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. A new edition can also be IENC data that has previously been produced for this area and at the same maximum display scale. The encoding structure is located in Annex B – clause B-5

- Update: Changing some information in an existing dataset. Each Update dataset file must have the same name as the original base cell file, with an extension number greater than or equal to 001 (see EEE in clause 11.3.2 below). They must not extend the geographical area covered by the base cell file to which they apply (see clause 4.5.2). The encoding structure for an update is located in Annex D – clause B-6

- Re-issue of a dataset: including all the updates applied to the original dataset up to the date of the reissue. A re-issue is intended to avoid unnecessary lading of the Base cell and all applicable updates individually for new users of the dataset, therefor does not contain any new

Kommentiert [BB56]: To be checked

Kommentiert [BB57]: To be checked

information additional to that previously issued by updates, and can be issued at any time. The encoding structure is located in Annex B – clause B-5

- Cancellation: The dataset is cancelled and is deleted from Inland ECDIS or ECS. The encoding structure for a cancellation file is located in Annex B – clause B7

"File-less" management of published S-401 base datasets and their textual or pictorial ENC support files is not allowed for this Edition of S-401, with the exception of IENC support file deletions or metadata "supportedResource" updates. That is, producing a S-100 Exchange Set which only includes the mandatory "CATALOG.XML" file with the dataset and/or IENC Support File Discovery Metadata without including the appropriate dataset, dataset update or IENC support file in the S-100 Exchange Set is not allowed other than for the above exception.

11.3.2 Dataset file naming

401CCCCØØØØØØØØØØ.EEE

The file name forms a unique S-401 identifier where:

- 401 - the first 3 characters identify the dataset as an S-401 dataset (mandatory).
- CCCC - the fourth to seventh characters identify the producer code of the issuing agency (mandatory for S-401). Where the producer code is derived from a 2 or 3 character format (for instance when converting S-57 ENCs), the missing characters of the producer code must be populated with zeros ("00" or "0" respectively) for the sixth and seventh characters of the dataset file name, as required.
- ØØØØØØØØØØ –
  - The eighth character indicates the navigational purpose (specificUsage).
  - The letter "A" (in the position "specificUsage") indicates, that the cell is displayed as overlay over other cells within a range of usages.

~~<<NOTE: Since there is no intended usage subfield anymore in S-401 which indicates the range of usages of overlay cells, this is temporarily deleted. If during the testingphase the necessity of this indication has been proven, a solution will be worked out. >>~~

  - The ninth to thirteenth characters (XXXXX) identify the waterway and the waterway distance.
  - For waterways with a length of more than 999 km: for example D1923
  - For waterways with a length of more than 99 km: for example RH123
  - For waterways with a length of more than 9 km: for example DCC23

  The use of the ninth to thirteenth characters is only a recommendation. In Brazilian waterways they identify the equivalent paper chart number.

  The ninth to seventeenth characters are optional and may be used in any way by the producer to provide the unique file name. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).

- .EEE – new datasets and new editions use 000, updates start at 001 and increment until a limit of 999 (mandatory). Re-issues use the same number as the last Update applied to the dataset. Cancellations use the next sequential number from the previous Update applied to the dataset.

Kommentiert [BB58]: To be checked

Kommentiert [BB59]: To be checked

Kommentiert [GM60]: Mandatory?

Kommentiert [BB61R60]: Digits 1 to 8 yes, already mentioned that 9-13 is only a recommendation

IEHG: keep

11.3.3 New Editions, Re-Issues, Updates and Cancellations

This section defines the sequencing of S-401 datasets for New Editions, Updates and Re-issues. In order to ensure that feature type updates are incorporated into an end user Inland ECDIS or ECS in the correct sequence without any omission, a number of parameters encoded in the data are used in the following way:

Edition number	When a dataset is initially created (Base dataset), the Edition number 1 is assigned to it. The Edition number is increased by 1 at each New Edition.
Update number	Update number 0 is assigned to a new dataset and a New Edition. The first Update dataset file associated with this new dataset must have Update number 1. The Update number must be increased by one for each consecutive Update, until a New Edition is released. A Re-issue of a dataset must have the Update number of the last Update applied to the dataset, and use the same Edition number.
~~**Update comment**~~	~~Comment for describing the change introduced by an Update.~~
Issue date	Date up to which the data producer has incorporated all applicable changes. The issue date must be greater than the previous issue date of the dataset.

In order to cancel a dataset, an Update dataset file is created for which the Edition number must be set to 0. This message 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 on in the correct sequential order from the last Update applied to the Base dataset file.

11.4 Support Files

11.4.1 IENC support files

IENC~~Dataset~~ support files offer supplementary information that can be included in an IENC exchange set.

- Text files must contain only ~~general~~ UTF-8 encoded text as defined by this standard (text consisting only of printable characters and without HTML, XML, or other markup). ~~(Extensible mark-up language (XML) supports UTF-8 character encoding).~~ **~~(TXT), (XML), (HTM)~~**
- Picture files can be in JPEG or TIFF 6.0 specification **(TIFF)**

Table 11-1 – IENC support file extensions

File Types	Extensions	Comment
Text	TXT	
	~~HTM~~	~~HTML files must only include inline or embedded Cascading Style Sheet (CSS) information and must not embed Javascript or other dynamic content for example, DHTML, Flash etc.~~
	XML	XML documents must only be included in accordance with guidance provided within the Encoding Guide (S-401 Annex A). This may include a schema for the validation of XML documents.

Kommentiert [BB62]: Not in S-101
COMEX2: could be deleted
IEHG: delete

Kommentiert [BB63]: Not in S-101
COMEX2: would be needed for facility files, if we keep them
IEHG keep

Picture	TIF	Baseline TIFF 6.0
	JPG	JPEG2000

~~*Table 63 - Support file extensions*~~

11.4.2 System support files

System support files used with the S-401 IENC Product Specification follow the general S-100 Framework principles without any specific S-401 IENC Product Specification restrictions. System support files include the Feature, Portrayal and Interoperability Catalogues; Language packs for Catalogues; and other system support files as required.

~~11.3.4~~11.4.3 IENC ~~S~~support ~~f~~File ~~n~~Naming

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

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

401CCCCØØØØØØØØØØ.EEE

The main part forms an identifier where:

- 401 - the first 3 characters identify the IENC support file as applicable to an S-401 dataset (mandatory).
- CCCC - the fourth to seventh characters identify the producer code of the issuing agency (mandatory). Where the producer code is derived from a 2 or 3 character format (for instance when converting S-57 ENCs), the missing characters of the producer code must be populated with zeros ("00" or "0" respectively) for the sixth and seventh characters of the IENC support file name, as required.
- ØØØØØØØØØØ - the eighth to the maximum seventeenth characters are optional and can be used in any way by the producer to provide the unique IENC support file name. The following characters are allowed in the support file name: A to Z, 0 to 9 and the special character _ (underscore).

US: Format is AARRMMMXNN.EXT where:

AA = 2-character Producer Code

RR = 2-character river code

MMM = 3-digit river mile or river km, 000-999

X = tenth of river mile/km; preceding decimal point implied; use zero if river mile/km known only to the nearest mile.

NN = 01-99; unique identifier for text file at the particular river mile/km.

For example, if three TXTDSC files exist at the same river mile/km, 01, 02, and 03 would be used.

EXT = 3-character file extension for Hypertext Metafile (HTM), ASCII text (TXT), or Standardized External XML file with communication information.

EUR: The ISRS Location Code or ~~MRN~~a UUID can be used for the file name of the external XML files, for example DEXXX039000000005023.XML.

- .EEE – IENC support file extension. (TXT, ~~HTM,~~ XML or TIF or JPG).

Kommentiert [BB64]: Should we add the MRN here?
IEHG:add MRN
MRN cannot be used because it is containing characters that are forbidden for file names.

Kommentiert [BB65]: Not in S-101

~~11.3.5~~11.4.4 Support ~~f~~File m~~M~~anagement

When a support file is created or a subsequent version is issued it must carry its own issue date and it may be supported with a digital signature which authenticates it against the P~~p~~roducer's public key included in the exchange set metadata.

The ~~type of support file is indicated in the~~ "~~purpose~~revisionStatus" field of the support file discovery metadata~~. Three types:~~ defines if the support file is new, replacement ~~and~~or deletion ~~are defined~~.

The "purpose" field of catalogue discovery metadata defines if the Catalogue is a new edition or a cancellation.

Support files carrying the "deletion" or "cancellation" flag must be removed ~~from the system~~ or archived. Upon receiving an~~When~~ IENC support file with the "SupportFileDiscoveryMetaData" field "revisionStatus" populated as "deletion" is received ~~a feature pointing to a text, picture or application file is deleted or updated so that it no longer references the file~~, the Inland ECDIS or ECS software must check to see whether any ~~other~~ feature~~s~~ reference~~d~~ the ~~same~~ IENC support file, ~~before that file is~~prior deleting or archiving the file ~~deleted~~.

~~Each support file required must be used only once in the exchange set.~~

Support files , with the exception of Catalogue files, must ~~should~~ be stored in a separate folder within the E~~e~~xchange S~~s~~et named SUPPORT_FILES~~, refer to Figure 25 – S-401 Exchange Set~~. The Catalogue files must be stored within the Exchange Set in a folder named "CATALOGUES". Refer to S-100 Part 17, clause 17-4.2 Figure 17-3 – An S-100 Exchange Set folder structure.

Reuse of a IENC support file name after a deletion ~~period~~ is possible only if the IENC support file edition number is higher than the previous edition number before the deletion.

Only the latest edition of a support file can be used. As soon as a new edition is created and installed, the older version is retired and can no longer be used by any feature.

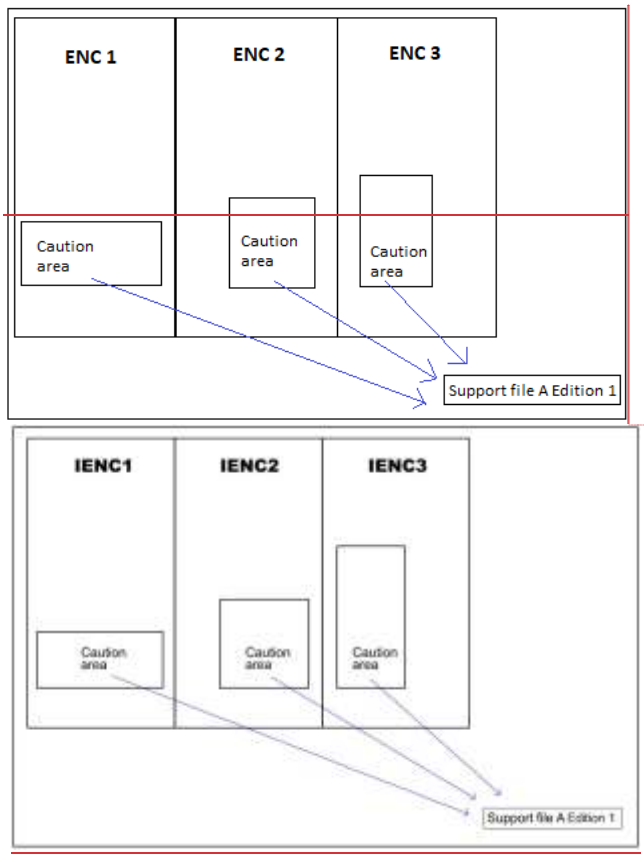
If an IENC support file is associated with multiple features in one or several datasets, a new edition of the file will immediately be used by all associated features.

If a N~~n~~ew E~~e~~dition of an IENC support file contains changes not applicable to all previous associated features, a completely new IENC support file must be created instead. This is to maintain the IENC support file information ~~in~~for the associated features not effected by the ~~last~~ changes. The associations to the ~~old~~original file must then be removed for the relevant features and new associations created for the new IENC support file and applied by IENC update. Features where changes were not applicable will continue to use the ~~old~~original IENC support file.

In all cases, the ENC update(s) and the associated new or updated IENC support file(s) must be included in the same Exchange Set. If the original IENC support file's supportFileDiscoveryMetadata "supportedResource" was originally populated to reference one of more IENCs, then it can be updated in the CATALOG.XML without adding the original IENC support file in the Exchange set.

The following scenario demonstrates the rules related to versioning and issuing of new IENC support files:

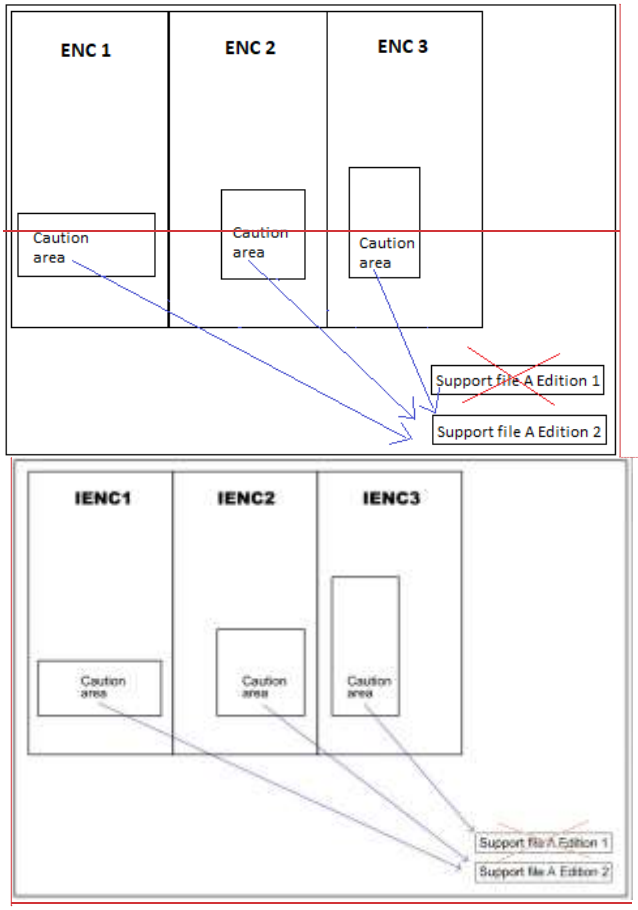
Three Caution areas are encoded within three different IENCs. All of them references the same IENC support file A:



Kommentiert [GM66]: Change picture: ENC 1 -> IENC 1, ENC 2 -> IENC 2, ...

Figure ~~19~~ 11-1 – Reference to new support file

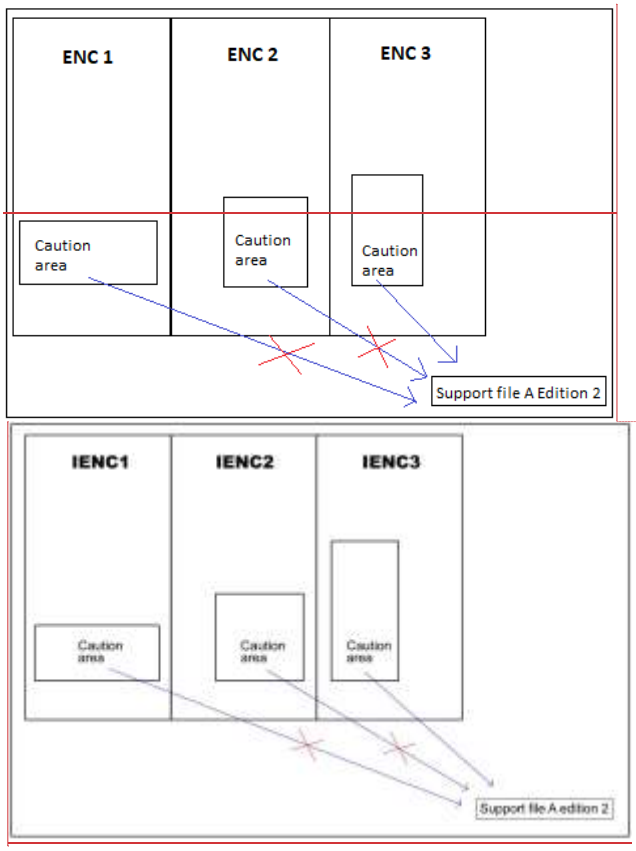
Figure 11-2: Changes occur making it necessary to issue a N~~n~~ew E~~e~~dition of IENC s~~S~~upport file A. Edition 1 is no longer valid, and all 3 caution areas refer to the N~~n~~ew E~~e~~dition of IENC s~~S~~upport file A (E~~e~~dition 1 of the ~~support~~ file is deleted from the system or not used if no longer referenced by ~~no~~any IENC features):



Kommentiert [GM67]: Change picture: ENC 1 -> IENC 1, ENC 2 -> IENC 2, ...

Figure 11-220 – Reference to a Nnew Eedition of an IENC support file

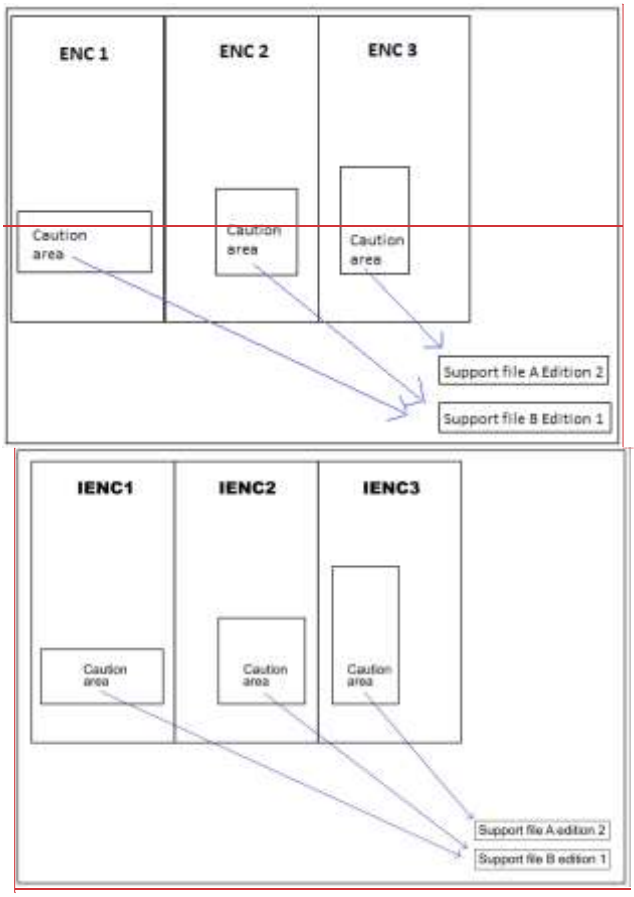
Figure 11-3: Changes occur that are only applicable to the Caution areas in IENC 1 and IENC 2. Consequently, these IENCs can no longer refer to IENC support file A Edition 2:



Kommentiert [GM68]: Change picture: ENC 1 -> IENC 1, ENC 2 -> IENC 2, ...

Figure 11-321 – Changes to IENC support file affecting limited referenced features

Figure 11-4: A new IENC support file B must be created for IENC 1 and IENC 2 to use as reference:



Kommentiert [GM69]: Change picture: ENC 1 -> IENC 1, ENC 2 -> IENC 2, ...

Figure ~~22-11-4~~ – A n~~N~~ew IENC support file affecting limited referenced features

NOTE: In Figure 11-4, if the IENC support file A Edition 2 Support File Discovery Metadata attribute "supportedResource" has been populated with all the previous IENC references, then the IENC support file A Edition 2 Support File Discovery Metadata should also be included and updated in the update Exchange Set CATALOG.XML with the "supportedResource" updated accordingly – now referencing only "IENC 3".

To simplify this process ~~it~~ consideration may be given to not populating the IENC Support File Discovery Metadata attribute "supportedResource" where the IENC support file is referenced in more than one IENC product (see S-100 Part 17, clause 17-4.3.1 – Supported resources / multiple references guide).

11.5 ~~11.5~~ **Associated** XML Metadata file

An associated XML Metadata file is expected to carry information specific to producing authorities' internal production procedures, and is not intended for use within the end user systems.

If used, all associated XML Metadata files must have unique names. The name of the associated XML Metadata file should not be used to describe the physical content of the file.

The associated XML Metadata file must be named according to the specification given below:

MD <data file base name>.XML

~~11.4~~11.6 S-401 Exchange Catalogue

The S-401 exchange catalogue acts as the table of contents for the S-100 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 contents of the S-401 exchange catalogue are described in Clause 12.

~~11.5~~11.7 Data integrity and encryption

See S-100 Parts 15 and 17. ~~Out of scope for S-01 Edition 1.0.0. Under development by S-100WG and will be included for Edition 2.0.0.~~

12 Metadata

12.1 Introduction

For information exchange, there are several categories of metadata required: metadata about the overall exchange catalogue, metadata about each of the datasets contained in the catalogue, and metadata about the support files that make up the package.

S-100 Part 17, Figures 17-1, 17-6 and 17-7 ~~Figures 23 to 26~~ outline the overall concept of an S-1~~4~~001 Eexchange Sset for the interchange of geospatial data and its relevant metadata. Figure 17-1~~23~~ depicts the realization of the ISO 19115-1 and 19115-3 classes which form the foundation of the Eexchange Sset. The overall structure of S-401 metadata for Eexchange Ssets is the same as S-100 metadata., Figure 17-6 depicts the structure of the Exchange Set Catalogue and the structure of the Exchange Set as included in S-100 part 17, Figure 17-1 is also described in clause 11.2 above.~~which is modelled in Figures 24 and 25~~. More detailed information about the various classes is shown in Figure ~~26~~ 17-7 and a textual description in the tables at clauses 12.1.1 to 12.1.4.

The discovery metadata classes have numerous attributes which ~~enable~~ expose important information about the ~~datasets~~IENCs, ~~and accompanying~~ IENC support files and system support files to be examined without the need to process the data, for example, decrypt, decompress, load etc.

~~Other~~Sysyem support files, such as Feature and Portrayal Cc~~e~~atalogues or codelist dictionary files, can be included in the Eexchange Sset in support of the ~~datasets such as feature and portrayal~~end-user system. The attribute "resourcePpurpose" of the IENC Ssupport Ffile Discovery Mm~~m~~etadata provides a mechanism to "read" and apply these system~~update~~ support files more easily.

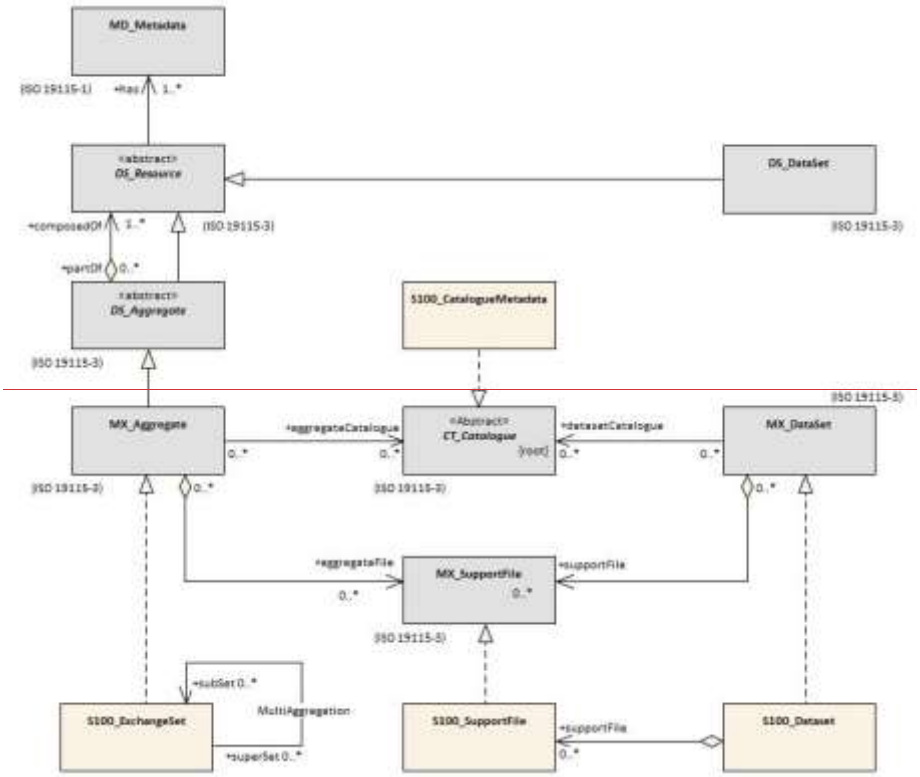
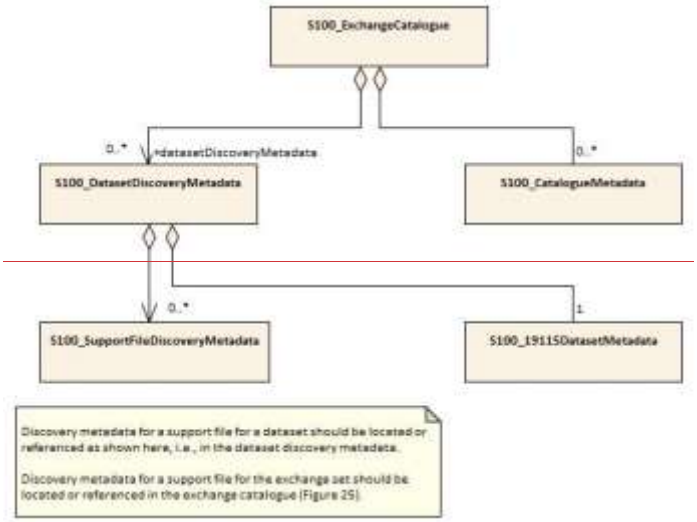
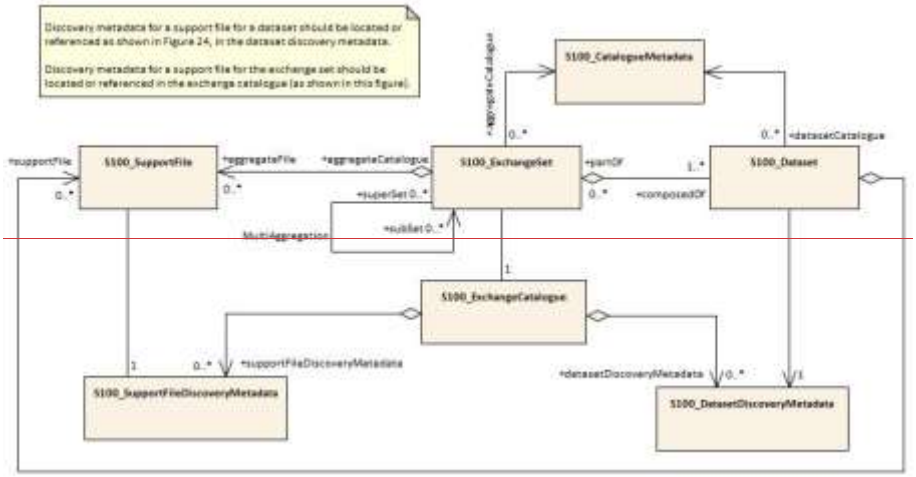


Figure 23 Realization of the Exchange Set Classes



~~*Figure 24 – S-401 ExchangeSet Catalogue*~~



~~*Figure 25 - S-401 Exchange Set*~~

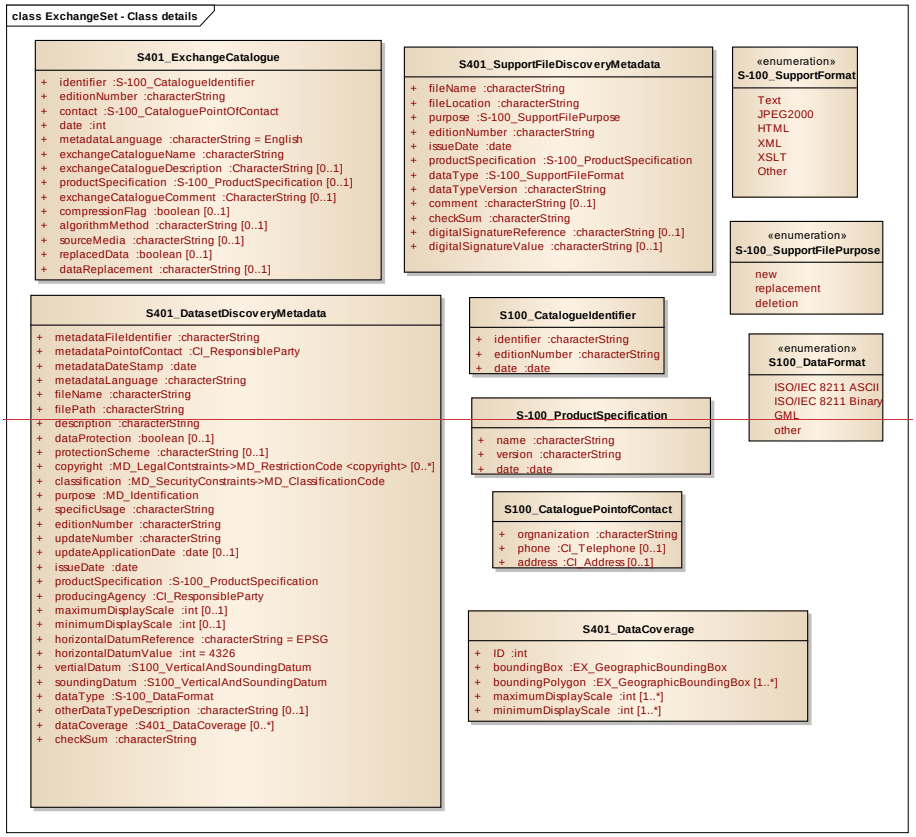


Figure 26 S-401 Exchange Set - Class Details

The following clauses define the mandatory and optional metadata needed for S-401. In some cases the metadata may be repeated in a national language. If this is the case it is noted in the Remarks column.

In the following clauses, wherever S-401 makes an optional S-100 metadata attribute mandatory (that is, restricts multiplicity from 0.. to 1..), the restricted multiplicity is shown in place of the multiplicity given in S-100 Part 174a, and a comment noting the restricted multiplicity has been included in the Remarks column.

. These attributes are named in the note in Figure 26. Further, enumerations in Figure 26 and the following clauses show only the values allowed in S-401 exchange catalogues.

12.1.1 S100_ExchangeCatalogue

Kommentiert [GM70]: All tables needs to be checked

~~The catalogue file is defined in XML schema language.~~ The Exchange Ccatalogue inherits the Ddataset Ddiscovery Mmetadata, Support File Discovery Metadata and Catalogue Discovery Metadata ~~and support file discovery metadata~~ from S-100 with additional S-401-specific restrictions.

Name	Description	Mult	Type	Remarks
S100_ExchangeCatalogue	An Exchange Catalogue contains the discovery metadata about the exchange datasets and support files	-		-
identifier	Uniquely identifies this Exchange Catalogue	1	S100_ExchangeCatalogueIdentifier	0..1 multiplicity in S-100 restricted to 1 in S-401
contact	Details about the issuer of this Exchange Catalogue	1	S100_CataloguePointOfContact	0..1 multiplicity in S-100 restricted to 1 in S-401
productSpecification	Details about the Product Specifications used for the datasets contained in the Exchange Catalogue	1..*	S100_ProductSpecification	The Exchange Catalogue may contain datasets from Product Specifications other than S-401 0..* multiplicity in S-100 restricted to 1..* in S-401
defaultLocale	Default language and character set used for all metadata records in this Exchange Catalogue	1	PT_Locale	All datasets conforming to S-101 Product Specification must use English language as default locale 0..1 multiplicity in S-100 restricted to 1 in S-401
otherLocale	Other languages and character sets used for the localized metadata records in this Exchange Catalogue	0..*	PT_Locale	Required if any localized entries are present in the Exchange Catalogue
exchangeCatalogueDescription	Description of what the Exchange Catalogue contains	0..1	CharacterString	
exchangeCatalogueComment	Any additional Information	0..1	CharacterString	
certificates	Signed public key certificates referred to by digital signatures in the Exchange Set	0..*	S100_SE_CertificateContainerType	Content defined in S-100 Part 15. All certificates used, except the SA root certificate (installed separately by the implementing system) shall be included
dataServerIdentifier	Identifies the data server for the permit	0..1	CharacterString	
datasetDiscoveryMetadata	Exchange Catalogues may include or reference discovery metadata for the datasets in the Exchange Set	0..*	Aggregation S100_DatasetDiscoveryMetadata	

catalogueDiscoveryMetadata	Metadata for Catalogue	0..*	Aggregation S100_CatalogueDiscoveryMetadata	Metadata for the Feature, Portrayal, and Interoperability Catalogues, if any
supportFileDiscoveryMetadata	Exchange Catalogues may include or reference discovery metadata for the support files in the Exchange Set	0..*	Aggregation S100_SupportFileDiscoveryMetadata	

12.1.1.1 S100_ExchangeCatalogueIdentifier

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_ExchangeCatalogueIdentifier	An Exchange Catalogue contains the discovery metadata about the exchange datasets and support files	-	-	The concatenation of identifier and dateTime form the unique name
Attribute	identifier	Uniquely identifies this Exchange Catalogue	1	CharacterString	<S100XC:identifier>US_401_20200101_120101_01</S100XC:identifier>
Attribute	dateTime	Creation date and time of the Exchange Catalogue, including time zone	1	DateTime	Format: yyyy-mm-ddThh:mm:ssZ

12.1.1.2 S100_CataloguePointOfContact

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_CataloguePointOfContact	Contact details of the issuer of this Exchange Catalogue	-	-	-
Attribute	organization	The organization distributing this Exchange Catalogue	1	CharacterString	This could be an individual producer, value added reseller, etc
Attribute	phone	The phone number of the organization	0..1	CI_Telephone	
Attribute	address	The address of the organization	0..1	CI_Address	

12.1.2 S100_DatasetDiscoveryMetadata

Name	Description	Mult	Type	Remarks
S100_DatasetDiscoveryMetadata	Metadata about the individual datasets in the Exchange Catalogue	-	-	-
fileName	Dataset file name	1	URI	See S-100 Part 1, clause 1-4.6
description	Short description giving the area or location covered by the dataset	0..1	CharacterString	For example, a harbour or port name, between two named locations etc See also Note 1

Name	Description	Mult	Type	Remarks
datasetID	Dataset ID expressed as a Maritime Resource Name (MRN)	0..1	URN	The URN must be an MRN
compressionFlag	Indicates if the resource is compressed	1	Boolean	*True* indicates a compressed dataset resource *False* indicates an uncompressed dataset resource
dataProtection	Indicates if the data is encrypted	1	Boolean	*True* indicates an encrypted dataset resource *False* indicates an unencrypted dataset resource
protectionScheme	Specification of method used for data protection	0..1	S100_ProtectionScheme	
digitalSignatureReference	Specifies the algorithm used to compute digitalSignatureValue	1	S100_SE_DigitalSignatureReference (see S-100 Part 15)	
digitalSignatureValue	Value derived from the digital signature	1..*	S100_SE_DigitalSignature (see S-100 Part 15)	The value resulting from application of digitalSignatureReference. Implemented as the digital signature format specified in S-100 Part 15
copyright	Indicates if the dataset is copyrighted	1	Boolean	*True* indicates the resource is copyrighted *False* indicates the resource is not copyrighted
classification	Indicates the security classification of the dataset	1	Class MD_SecurityConstraints>MD_ClassificationCode (codelist)	1. unclassified 2. restricted 3. confidential 4. secret 5. top secret 6. sensitive but unclassified 7. for official use only 8. protected 9. limited distribution 0..1 multiplicity in S-100 restricted to 1 in S-4101
purpose	The purpose for which the dataset has been issued	1	S100_Purpose	0..1 multiplicity in S-100 restricted to 1 in S-4101
notForNavigation	Indicates the dataset is not intended to be used for navigation	1	Boolean	*True* indicates the dataset is not intended to be used for navigation *False* indicates the dataset is intended to be used for navigation
specificUsage	The use for which the dataset is intended	0..1	MD_USAGE>specificUsage (character string)	

Name	Description	Mult	Type	Remarks
editionNumber	The Edition number of the dataset	1	Integer	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 update and re-issue 0..1 multiplicity in S-100 restricted to 1 in S-4101
updateNumber	Update number assigned to the dataset and increased by one for each subsequent update	1	Integer	Update number 0 is assigned to a new dataset 0..1 multiplicity in S-100 restricted to 1 in S-4101
updateApplicationDate	This date is only used for the base cell files (that is new data set, re-issue and new edition), not update cell files. All updates dated on or before this date must have been applied by the producer	0..1	Date	
referenceID	Reference back to the datasetID	0..1	URN	Update metadata refers to the datasetID of the dataset metadata. This is used if and only if the dataset is an update The URN must be an MRN
issueDate	Date on which the data was made available by the Data Producer	1	Date	
issueTime	Time of day at which the data was made available by the Data Producer	0..1	Time	The S-100 datatype Time
boundingBox	The extent of the dataset limits	1	EX_GeographicBoundingBox	0..1 multiplicity in S-100 restricted to 1 in S-4101

Name	Description	Mult	Type	Remarks
temporalExtent	Specification of the temporal extent of the dataset	0..1	S100_TemporalExtent	The temporal extent is encoded as the date/time of the earliest and latest data records (in coverage datasets) or date/time ranges (in vector datasets) If there is more than one feature in a dataset, the earliest and latest time values of records in all features are used, which means the earliest and latest values may be from different features If date/time information for a feature is not encoded in the dataset, it is treated for the purposes of this attribute as extending indefinitely in the appropriate direction on the time axis, limited by the issue date/time or the cancellation or supersession of the dataset This attribute is encoded if and only if at least one of the start and end of the temporal extent is known
productSpecification	The Product Specification used to create this dataset	1	S100_ProductSpecification	
producingAgency	Agency responsible for producing the data	1	CI_Responsibility>CI_Organisation	See S-100 Part 17, Table 17-3
producerCode	The official IHO S-100 Producer Code from the IHO GI Registry, Producer Code Register	1	CharacterString	0..1 multiplicity in S-100 restricted to 1 in S-4101
encodingFormat	The encoding format of the dataset	1	S100_EncodingFormat	For S-4101 datasets must be ISO/IEC 8211
dataCoverage	Provides information about data coverages within the dataset	1..*	S100_DataCoverage	0..* multiplicity in S-100 restricted to 1..* in S-4101
comment	Any additional information	0..1	CharacterString	
defaultLocale	Default language and character set used in the dataset	0..1	PT_Locale	In absence of defaultLocale the language is English, UTF-8
otherLocale	Other languages and character sets used in the dataset	0..*	PT_Locale	
metadataPointOfContact	Point of contact for metadata	0..1	CI_Responsibility>CI_Individual or CI_Responsibility>CI_Organisation	Only if metadataPointOfContact is different to producingAgency
metadataDateStamp	Date stamp for metadata	0..1	Date	Metadata creation date, which may or may not be the dataset creation date

Name	Description	Mult	Type	Remarks
replacedData	Indicates if a cancelled dataset is replaced by another data file(s)	0..1	Boolean	See Note 2
dataReplacement	Dataset name	0..*	CharacterString	A dataset may be replaced by 1 or more datasets See Note 2
navigationPurpose	Classification of intended navigation purpose (for Catalogue indexing purposes)	1	S100_NavigationPurpose	0..3 multiplicity in S-100 restricted to 1 in S-4101
resourceMaintenance	Information about the frequency of resource updates, and the scope of those updates	0..1	MD_MaintenanceInformation	S-100 restricts the multiplicity to 0..1 and adds specific restrictions on the ISO 19115 structure and content. See clause MD_MaintenanceInformation later in this Part Format: PnYnMnDTnHnMnS (XML built-in type for ISO 8601 *duration*). See S-100 Part 17, clause 17-4.9

~~NOTE 1: description: During the ENC Dual-Fuel transition period, it is recommended that the attribute description is used to identify equivalent S-57 ENCs in S-101. This information is to be semicolon separated to distinguish it from any other information, for example for 1 to 1 mapping <XC:description>;GB5DNABH;</XC:description> and for more than one equivalent S-57 ENC: <XC:description>;NL4NZ110;NL5WS130;</XC:description>. If the mapping is partial, a "p" should be included at the end of the S-57 dataset name, for example <XC:description>;GB5DNABHp;</XC:description>. There may be scenarios for non-ECDIS use only, where S-101 ENCs are produced without equivalent S-57 ENCs; this should be shown using an "n" as <XC:description>;n;</XC:description>~~

NOTE 2: replacedData and dataReplacement: The attribute replacedData is mandatory if the attribute purpose (see clause 12.1.2.3) is set to value *5* (cancellation). The attribute dataReplacement is mandatory if replacedData = *True*.

Kommentiert [JW71]: Refer to Paper S-101PT13-07.11 and Decisions and Actions from S-101PT13.

Kommentiert [BB72R71]: If we keep it, it has to be adapted

Kommentiert [BB73R71]: IEHG: delete the Note

12.1.2.1 S100_NavigationPurpose

Item	Name	Description	Code	Remarks
Enumeration	S100_NavigationPurpose	The purpose of the dataset	-	
Value	port	For port and near shore operations	1	-
Value	transit	For coast and planning purposes	2	-
Value	overview	For ocean crossing and planning purposes	3	-

~~12.1.1.3~~12.1.2.2 S100_DataCoverage

Name	Multiplicity	Value	Type	Remarks
S100_DataCoverage	-	-	-	-

boundingPolygon	1		EX_BoundingPolygon	
temporalExtent	0..1		S100_TemporalExtent	The remarks for *temporalExtent* in the dataset discovery block (S100_DatasetDiscoveryMetadata) apply, except that their scope is the individual coverage and not the dataset as a whole
optimumDisplayScale	1		Integer	Must be one of the following values: 200 500 1000 2000 3000 4000 8000 12000 22000 45000 90000 180000 350000 700000 1500000 3500000 10000000 0..1 multiplicity in S-100 restricted to 1 in S-401
maximumDisplayScale	1		Integer	Any value 0..1 multiplicity in S-100 restricted to 1 in S-401
minimumDisplayScale	1		Integer	Must be one of the following values: 200 500 2000 3000 4000 8000 12000 22000 45000 90000 180000 350000 700000 1500000 3500000 10000000

Kommentiert [BB74]: Add 200 and 500?

IEHG yes

Kommentiert [BB75]: Add 200 and 500?

				NULL 0..1 multiplicity in S-100 restricted to 1 in S-401

12.1.2.3 S100_Purpose

Item	Name	Description	Code	Remarks
Enumeration	S100_Purpose	The purpose of the dataset	-	
Value	newDataset	Brand new dataset	1	No data has previously been produced for this area
Value	newEdition	New edition of the dataset or Catalogue	2	Includes new information which has not been previously distributed by updates
Value	update	Dataset update	3	Changing some information in an existing dataset
Value	reissue	Dataset that has been re-issued	4	Includes all the updates applied to the original dataset up to the date of the re-issue. A re-issue does not contain any new information additional to that previously issued by updates
Value	cancellation	Dataset or Catalogue that has been cancelled	5	Indicates the dataset or Catalogue should no longer be used and can be deleted

12.1.2.4 S100_TemporalExtent

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_TemporalExtent	Temporal extent	--		At least one of the timeInstantBegin and timeInstantEnd attributes must be populated; if both are known, both must be populated. The absence of either begin or end indicates indefinite validity in the corresponding direction, limited by the issue date/time or the cancellation or supersession of the dataset
Attribute	timeInstantBegin	The instant at which the temporal extent begins	0..1	DateTime	
Attribute	timeInstantEnd	The instant at which the temporal extent ends	0..1	DateTime	

12.1.2.5 S100_EncodingFormat

Item	Name	Description	Code	Remarks
Enumeration	S100_EncodingFormat	The encoding format	-	Values listed in S-100 Part 17 but not mentioned in this table are not allowed
Value	ISO/IEC 8211	The ISO 8211 data format as defined in S-100 Part 10a	1	

~~12.1.1.4~~12.1.2.6 S100_ProductSpecification

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_ProductSpecification	The Product Specification contains the information needed to build the specified product	-	-	-
Attribute	name	The name of the product specification used to create the datasets	1	CharacterString	S401 Inland Electronic Navigational Charts 0..1 multiplicity in S-100 restricted to 1 in S-401
Attribute	version	The version number of the product specification	1	CharacterString	~~X.X.X~~1.2.0 0..1 multiplicity in S-100 restricted to 1 in S-401
Attribute	date	The version date of the product specification	1	Date	0..1 multiplicity in S-100 restricted to 1 in S-401
Attribute	productIdentifier	Machine readable unique identifier of a product type	1	CharacterString (Restricted to Product ID values from the IHO Product Specification Register, in the IHO Geospatial Information (GI) Registry)	"S-401" (without quotes)

Attribute	nNumber	The number (registry index) used to lookup the product in the Product Specification Register	1	Integer	From the Product Specification Register in the IHO Geospatial Information Registry
Attribute	compliancyCategory	The level of compliance of the Product Specification to S-100	1	S100_CompliancyCategory	0..1 multiplicity in S-100 restricted to 1 in S-401. Needed for S-98 interoperability

12.1.2.7 S100_CompliancyCategory

Item	Name	Description	Code	Remarks
Enumeration	S100_CompliancyCategory		-	All S-4101 products fully conforming to this Product Specification would be category3 ~~or category4. (S-101 is expected to be category4, but the requirements for harmonized display are being determined, so category3 is provisionally retained to allow for potential divergences between S-101 and those requirements while both specifications are being finalised. In the absence of specific guidance to the contrary from the S-101 project team use category4)~~ if not otherwise stated by IEHG
Value	category3	IHO S-100 compliant with standard encoding	3	
Value	category4	IHO S-100 and IMO harmonized display compliant	4	

Kommentiert [BB76]: Shouldn' we state that S-401 is category 3?
COMEX 2: category 3 if not otherwise stated by IEHG

IEHG yes

12.1.2.8 S100_ProtectionScheme

Item	Name	Description	Code	Remarks
Enumeration	S100_ProtectionScheme	Data protection schemes	-	-
Value	S100p15	IHO S-100 Part 15	1	See S-100 Part 15

~~12.1.2~~ S100_SupportFileDiscoveryMetadata

Name	Description	Mult	Type	Remarks
S100_SupportFileDiscoveryMetadata	Metadata about the individual support files in the Exchange Catalogue	-	-	-
fileName	Name of the support file	1	URI	See S-100 Part 1, clause 1-4.6
revisionStatus	The purpose for which the support file has been issued	1	S100_SupportFileRevisionStatus	For example new, replacement, etc
editionNumber	The Edition number of the support file	1	Integer	When a data set 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	Date on which the data was made available by the Data Producer	0..1	Date	
supportFileSpecification	The specification used to create this file	1	S100_SupportFileSpecification	0..1 multiplicity in S-100 restricted to 1 in S-401.
dataType	The format of the support file	1	S100_SupportFileFormat	Constrained to TXT, TIF and JPG – see clause 11.4.1
comment	Optional comment	0..1	CharacterString	Any additional Information
compressionFlag	Indicates if the resource is compressed	1	Boolean	*True* indicates a compressed resource *False* indicates an uncompressed resource
digitalSignatureReference	Specifies the algorithm used to compute	1	S100_SE_DigitalSignatureReference (see Part	

	digitalSignatureValue		15)	
digitalSignatureValue	Value derived from the digital signature	1..*	S100_SE_DigitalSignature (see Part 15)	The value resulting from application of digitalSignatureReference Implemented as the digital signature format specified in S-100 Part 15
defaultLocale	Default language and character set used in the support file	0..1	PT_Locale	A support file is expected to use only one as locale. Additional support files can be created for other locales
supportedResource	Identifier of the resource supported by this support file	0..*	CharacterString	Conventions for identifiers are detailed in S-100 Part 15. S-100 allows file URI, digital signature or cryptographic hash checksums to be used
resourcePurpose	The purpose of the supporting resource	0..1	S100_ResourcePurpose	Identifies how the supporting resource is used

NOTE: The optional S-100 field *otherDataTypeDescription* is not allowed in S-401.

~~S401~~S100_**Support~~File~~Format**

Role Name	Name	Description	Mult	Remarks
Enumeration	S100_SupportFileFormat	The format used for the support file	-	Values listed in S-100 Part 17 but not mentioned in this table are not allowed
Value	TXT_UTF-8	UTF-8 text excluding control codes	1	This is the only format allowed for a textual ENC Support file
Value	XML	XML	1	e.g. for standardized external XML
Value	TIFF	Tagged Image File Format	7	This is the only format allowed for a textual ENC Support file
Value	JPEG2000	JPEG2000 format	2	ISO 15444

Kommentiert [BB77]: HTML and XML dleted in S-101 2.0.0

12.1.2.9 S100_SupportFileRevisionStatus

Item	Name	Description	Code	Remarks
Enumeration	S100_SupportFileRevisionStatus	The reason for inclusion of the support file in	-	-

		this exchange set		
Value	new	A file which is new	1	Signifies a new file
Value	replacement	A file which replaces an existing file	2	Signifies a replacement for a file of the same name
Value	deletion	Deletes an existing file	3	Signifies deletion of a file of that name

12.1.2.10 S100_SupportFileSpecification

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_SupportFileSpecification	The standard or specification to which a support file conforms	-	-	-
Attribute	name	The name of the specification used to create the support file	1	CharacterString	
Attribute	version	The version number of the specification	0..1	CharacterString	
Attribute	date	The version date of the specification	0..1	Date	

12.1.2.11 S100_ResourcePurpose

Item	Name	Description	Code	Remarks
Enumeration	S100_ResourcePurpose	Defines the purpose of the supporting resource	-	-
Value	supportFile	A support file	1	An IENC support file
Value	ISO Metadata	Dataset metadata in ISO format	2	Not to be used for IENC distribution and use in navigational end-user systems. See clause 11.5
Value	Language Pack	A Language pack	3	A system support file
Value	GML Schema	GML Application Schema	4	Not used in the S-401 IENC Product Specification
Value	other	A type of resource not otherwise described	100	A system support file

12.1.3 S100_CatalogueDiscoveryMetadata

This is an optional element that allows for the delivery of S-41~~1~~01 Feature and Portrayal Catalogues within the Exchange Set.

Name	Description	Mult	Type	Remarks

S100_CatalogueDiscoveryMetadata	Class for S-100 Catalogue metadata	-	-	-
fileName	The name for the Catalogue	1	URI	See S-100 Part 1, clause 1-4.6
purpose	The purpose for which the Catalogue has been issued	0..1	S100_Purpose	The values must be one of the following: 2. new edition 5. cancellation Default is new edition
editionNumber	The Edition number of the Catalogue	1	Integer	Initially set to 1 for a given productSpecification.number Increased by 1 for each subsequent New Edition Uniquely identifies the version of the Catalogue
scope	Subject domain of the Catalogue	1	S100_CatalogueScope	
versionNumber	The version identifier of the Catalogue	1	CharacterString	Human readable version identifier
issueDate	The issue date of the Catalogue	1	Date	
productSpecification	The Product Specification used to create this file	1	S100_ProductSpecification	
digitalSignatureReference	Specifies the algorithm used to compute digitalSignatureValue	1	S100_SE_DigitalSignatureReference (see Part 15)	Reference to the appropriate digital signature algorithm
digitalSignatureValue	Value derived from the digital signature	1..*	S100_SE_DigitalSignature (see Part 15)	The value resulting from application of digitalSignatureReference Implemented as the digital signature format specified in Part 15
compressionFlag	Indicates if the resource is compressed	1	Boolean	*True* indicates a compressed resource *False* indicates an uncompressed resource
defaultLocale	Default language and character set used in the Catalogue	1	PT_Locale	0..1 multiplicity in S-100 restricted to 1 in S-4101
otherLocale	Other languages and character sets used in the Catalogue	0..*	PT_Locale	

~~12.1.2.1~~12.1.3.1 S100_CatalogueScope

Role Name	Name	Description	Mult	Remarks
Class	S100_CatalogueScope	The scope of the Catalogue	-	-

Value	featureCatalogue	S-100 Feature Catalogue	1	
Value	portrayalCatalogue	S-100 Portrayal Catalogue	2	
Value	interoperabilityCatalogue	S-100 Interoperability Catalogue	3	

12.1.3.2 MD_MaintenanceInformation

Role Name	Name	Description	Mult	Type	Remarks
Class	MD_MaintenanceInformation	Information about the scope and frequency of updating	-	-	S-100 restricts the ISO 19115-class to: • prohibit maintenanceScope, maintenanceNote, and contact attributes; • define restrictions on maintenanceAndUpdateFrequency, maintenanceDate, and userDefinedMaintenanceFrequency attributes
Attribute	maintenanceAndUpdateFrequency	Frequency with which changes and additions are made to the resource after the initial resource is completed	0..1	MD_MaintenanceFrequencyCode (codelist)	Must be populated if userDefinedMaintenanceFrequency is not present, otherwise optional. See Table MD_MaintenanceFrequencyCode in this Part for values allowed in S-100 metadata
Attribute	maintenanceDate	Date information associated with maintenance of the resource	0..1	CI_Date	Exactly one of maintenanceDate and userDefinedMaintenanceFrequency must be populated Allowed value for dateType: nextUpdate
Attribute	userDefinedMaintenanceFrequency	Maintenance period other than those defined	0..1	TM_PeriodDuration	Exactly one of maintenanceDate and userDefinedMaintenanceFrequency must be populated Only positive durations allowed

12.1.3.3 MD_MaintenanceFrequencyCode

S-100 uses a subset of the values allowed in ISO 19115-1.

Item	Name	Description	Code	Remarks
Enumeration	MD_MaintenanceFrequencyCode	Frequency with which modifications and deletions are made to the data after it is first produced	-	S-100 is restricted to only the following values from the ISO 19115-1 codelist. The conditions for the use of a particular value are described in its Remarks
Value	asNeeded	Resource is updated as deemed necessary	1	Use only for datasets which normally use a regular interval for update or supersession, but will have the next update issued at an interval different from the usual Allowed if and only if userDefinedMaintenanceFrequency is not populated
Value	irregular	Resource is updated in intervals that are uneven in duration	2	Use only for datasets which do not use a regular schedule for update or supersession Allowed if and only if userDefinedMaintenanceFrequency is not populated

12.1.3.4 PT_Locale

Role Name	Name	Description	Mult	Type	Remarks
Class	PT_Locale	description of a locale	-	-	From ISO 19115-1
Value	language	designation of the locale language	1	LanguageCode	ISO 639-2 3-letter language codes.
Value	country	designation of the specific country of the locale language	0..1	CountryCode	ISO 3166-2 2-letter country codes
Value	characterEncoding	designation of the character set to be used to encode the textual value of the locale	1	MD_CharacterSetCode	UTF-8 is used in S-100

The class PT_Locale is defined in ISO 19115-1. LanguageCode, CountryCode, and MD_CharacterSetCode are ISO codelists which are defined in a resource file in the S-100 Edition 5.0.0 Schemas distribution.

12.2 Language

The exchange language must be English. Other languages may be used as a supplementary option. National geographic names can be left in their original national language using the complex attribute **fFeature nNname**.

Character strings must be encoded using the character set defined in ISO 10646-1, in Unicode Transformation Format-8 (UTF-8). A BOM (byte order mark) must not be used.

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Annex A – Data Classification and Encoding Guide

The “Data Classification and Encoding Guide” has been developed to provide consistent, standardized instructions for encoding S-100 compliant IENC data. This document has been laid out, as far as possible, along the lines of the IHO publication S-4, Part B “Chart Specifications of the IHO – Medium and Large-Scale National and International (INT) Charts”.

The purpose of the Data Classification and Encoding Guide is to facilitate S-401 encoding ~~to meet IHO standards~~ for the proper display of IENC in an S-100 based navigation system such as Inland ECDIS or ECS. The document describes how to encode information that the cartographer considers relevant to an IENC. The content of an IENC is at the discretion of the producer~~ing authority~~ provided that the conventions described within this document are followed. ~~A “producing authority” is a Hydrographic Office (HO) or an organization authorized by a government, HO or other relevant government institution to produce IENCs.~~ In addition to the minimum content described in this standard the competent authority may define additional elements of minimum content.

The S-401 Data Classification and Encoding Guide can be found in the Standards and Publications page of the IEHG web site, https://ienc.openecdis.org.

Kommentiert [BB78]: ???

IEHG delete

Kommentiert [BB79]: ???
COMEX 2 : delete reference to IHO
IEHG yes

Kommentiert [BB80]: Replace authority with producer?
COMEX 2: amended

IEHG yes

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ANNEX B - NORMATIVE

Data Product format (encoding)

Introduction

S-401 uses the S-100 profile of ISO/IEC 8211 (refer to S-100 Part 10A) to encapsulate data. This annex specifies the interchange format to facilitate the moving of files containing data records between computer systems. It defines a specific structure which can be used to transmit files containing data type and data structures specific to S-401.

B-1 Dataset files

The order of data in each base or update dataset file is described below:

Dataset file
- Dataset Ggeneral iinformation record
- ~~Dataset structure information field structure~~
- Dataset Coordinate Reference System record ~~structure~~
- Information Type records
- ~~Information~~

~~Vector records~~
- Point records
- Multi point records
- Curve records
- Composite Curve records
- Surface records
- Feature type records
- ~~Meta features~~
- ~~Geo features~~
- ~~Aggregated features~~

For information Type records, Composite Curve records, and Feature Type records it must be ensured that any record that is referenced is stored before the record that references it.~~This order of records will enable the import software to check that the child record exists each time the parent record references it (That is it will already have read the child record so it will know if it exists or not).~~

B-2 Records

Records and fields that do not appear in the following tree structure diagrams are prohibited. The order of records in the files must be the same as that described in these tree structure diagrams.

The combination of the file name and the ‘‘Name’’ of the record must provide a unique world-wide identifier of the record. The “Name” of the record is the combination of the subfields RCNM and RCID in the appropriate Identifier field of the record.

B-3 Fields

For base dataset files, some fields may be repeated (indicated by <0..*> or <1..*>) and all of their content may be repeated (indicated by *). In order to reduce the volume of data, the encoder should repeat the sequence of subfields, in preference to creating several fields.

B-4 Subfields

Mandatory subfields must be filled by a non-null value.

Prohibited subfields must be encoded as missing subfields values. The exact meaning of missing attribute values is defined in Annex A.

In the tables following the tree structure diagrams, prescribed values are indicated in the “values” column.

When encoding new base datasets the record update instruction (RUIN) is always set to “insert”. When encoding updates it can be set to “Insert”, “Modify” or “Delete”.

B-5 Base dataset structure

NOTE: The number contained in parenthesis () is the number of subfields that are contained in the field.

```
Base dataset file
   |
   |--<1>- Dataset General Information record
   |   |
   |   |--<1>-DSID (13\\*1): spci
   |        |
   |        |--<1>-DSSI (13): Dataset Structure Information field
   |        |
   |        |--<0..1>-ATCS (*2): Attribute Codes field
   |        |
   |        |--<0..1>-ITCS (*2): Information Type Codes field
   |        |
   |        |--<0..1>-FTCS (*2): Feature Type Codes field
   |        |
   |        |--<0..1>-IACS (*2): Information Association Codes field
   |        |
   |        |-<0..1>-FACS (*2): Feature Association Codes field
   |        |
   |        |-<0..1>-ARCS (*2): Association Role Codes field
   |        |
   |           |
   |
   |--<1>--Dataset Coordinate Reference System record
   |   |
   |   |--<1>-CSID (3): Coordinate Reference System Record Identifier field
   |       |
   |       |--<1..*>-CRSH (7): Coordinate Reference System Header field
   |          |
   |          |--<0..1>-CSAX (*2): Coordinate System Axes field
   |          |
   |          |--<0..1>-VDAT (4): Vertical Datum field
   |
   |
   |--<0..*>--Information record
   |   |
   |   |--<1>-IRID (5): Information Type Record Identifier field
   |      |
   |      |--<0..*>- ATTR (*5): Attribute field
   |      |
```

```
|      |--<0..*>- INAS (5\\*5): Information Association field
|
|
|--<0..*>-- Point record
|   |
|   |--<1>-PRID (4): Point Record Identifier field
|      |
|      |-<0..*>-INAS (5\\*5): Information Association field
|      |
|      | alternate coordinate representations
|      |
|      *-<1>-C2IT (2): 2-D Integer Coordinate Tuple field
|      |
|      *-<1>-C3IT (4): 3-D Integer Coordinate Tuple field
|
|
|--<0..*>-- Multi Point record
|   |
|   |--<1>-MRID (4): Multi Point Record Identifier field
|      |
|      |-<0..*>-INAS (5\\*5): Information Association field
|      |
|      | alternate coordinate representations
|      |
|      *-<0..*>-C2IL (*2): 2-D Integer Coordinate List field
|      |
|      *-<0..*>-C3IL (1\\*3): 3-D Integer Coordinate List field
|
|
|--<0..*>-- Curve record
|   |
|   |--<1>-CRID (4): Curve Record Identifier field
|      |
|      |-<0..*>-INAS (5\\*5): Information Association field
|      |
|      |-<1>-PTAS (*3): Point Association field
|      |
|      |-<1>-SEGH (8): Segment Header field
|          |
|          |-<1..*>-C2IL (*2): 2-D Integer Coordinate List field
|
|
|--<0..*>-- Composite Curve record
|   |
|   |--<1>-CCID (4): Composite Curve Record Identifier field
|      |
|      |-<0..*>-INAS (5\\*5): Information Association field
|      |
|      |-<10..*>-CUCO (*3): Curve Component field
|
|
|--<0..*>-- Surface record
|   |
|   |--<1>-SRID (4): Surface Record Identifier field
|      |
|      |-<0..*>-INAS (5\\*5): Information Association field
|      |
|      |-<1..*>-RIAS (*5): Ring Association Field
|
|
```

```
|--<0..*>-- Feature Type record
    |
    |--<1>-FRID (5): Feature Type Record Identifier field
       |
       |-<1>-FOID (3): Feature Object Identifier field
       |
       |-<0..*>-ATTR (*5): Attribute field
       |
       |-<0..*>-INAS (5\\*5): Information Association field
       |
       |-<0..*>-SPAS (*6): Spatial Association field
       |
       |-<0..*>-FASC (5\\*5): Feature Association field
       |
       |-<0..*>-MASK (*4): Masked Spatial Type field
```

B-5.1 Field Content

B-5.1.1 Dataset Identification field - DSID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{10}	b11	{10} – Data Sset Identification
Record identification number	RCID	{1}	b14	Only one record
Encoding specification	ENSP	'S-100 Part 10a'	A()	Encoding specification that defines the encoding
Encoding specification edition	ENED	"1.1"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-401.1.0"	A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED	"1.0"	A()	Edition of the Pproduct Sspecification
Application profile	PROF	"1"	A()	"1" – EN Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLG	"EN"	A()	The (primary) language used in this dataset
Dataset abstract	DSAB	omitted	A()	The abstract of the dataset
Dataset edition	DSED		A()	See clause ??11.3.3
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

B-5.1.2 Dataset Structure Information field - DSSI

Subfield name	Label	Value	Format	Comment
Dataset Coordinate Origin X	DCOX	{0.0}	b48	Shift used to adjust x-coordinate before encoding
Dataset Coordinate Origin Y	DCOY	{0.0}	b48	Shift used to adjust y-coordinate before encoding
Dataset Coordinate Origin Z	DCOZ	{0.0}	b48	Shift used to adjust z-coordinate before encoding
Coordinate multiplication factor for x-coordinate	CMFX	$\{10^7\}$	b14	Floating point to integer multiplication factor for the x-coordinate or longitude
Coordinate multiplication factor for y-coordinate	CMFY	$\{10^7\}$	b14	Floating point to integer multiplication factor for the y-coordinate or latitude
Coordinate multiplication factor for z-coordinate	CMFZ	{100}	b14	Floating point to integer multiplication factor for the z-coordinate or depths or height
Number of Information Type records	NOIR		b14	Number of information records in the dataset
Number of Point records	NOPN		b14	Number of point records in the dataset
Number of Multi Point records	NOMN		b14	Number of multi point records in the dataset
Number of Curve records	NOCN		b14	Number of curve records in the dataset
Number of Composite Curve records	NOXN		b14	Number of composite curve records in the dataset

Number of Surface records	NOSN		b14	Number of surface records in the dataset
Number of Feature Type records	NOFR		b14	Number of feature records in the dataset

B-5.1.3 Attribute Codes field structure - ATCS

Subfield name	Label	Value	Format	Comment
Attribute Code	ATCD		A	The code as defined in the Ffeature Ccatalogue
Attribute Numeric Code	ANCD		b12	The code used within the NATC subfield

B-5.1.4 Information Type Codes field structure - ITCS

Subfield name	Label	Value	Format	Comment
Information Type Code	ITCD		A	The code as defined in the Ffeature Ccatalogue
Information Type Numeric Code	ITNC		b12	The code used within the NITC subfield

B-5.1.5 Feature Type Codes field structure - FTCS

Subfield name	Label	Value	Format	Comment
Feature Type Code	FTCD		A	The code as defined in the Ffeature Ccatalogue
Feature Type Numeric Code	FTNC		b12	The code used within the NFTC subfield

B-5.1.6 Information Association Codes field structure - IACS

Subfield name	Label	Value	Format	Comment
Information Association Code	IACD		A	The code as defined in the Ffeature Ccatalogue
Information Association Numeric Code	IANC		b12	The code used within the NIAC subfield

B-5.1.7 Feature Association Codes field structure - FACS

Subfield name	Label	Value	Format	Comment
Feature Association Code	FACD		A	The code as defined in the Ffeature Ccatalogue
Feature Association Numeric Code	FANC		b12	The code used within the NFAC subfield

B-5.1.8 Association Role Codes field structure - ARCS

Subfield name	Label	Value	Format	Comment
Association Role Code	ARCD		A	The code as defined in the Ffeature Ccatalogue
Association Role Numeric Code	ARNC		b12	The code used within the NARC subfield

B-5.1.9 Coordinate Reference System Record Identifier field - CSID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{15}	b11	{15} - Coordinate Reference System Identifier
Record identification number	RCID	{1}	b14	Only one record
Number of CRS Components	NCRC		b11	{1} - Single CRS (No C3IT or C3IL fields in the dataset) >{1} - Compound CRS

B-5.1.10 Coordinate Reference System Header field - CRSH

Subfield name	Label	Value	Format	Comment
CRS index	CRIX		b11	1 – for the horizontal CRS >1 – for the vertical CRS's
CRS Type	CRST	{1} or {5}	b11	{1} – 2D Geographic {5} - Vertical
Coordinate System Type	CSTY	{1} or {3}	b11	{1} - Ellipsoidal CS {3} - Vertical CS
CRS Name	CRNM	"WGS84" for horizontal CRS "Depth - *" for vertical CRS where * is the name of the vertical datum	A()	
CRS Identifier	CRSI	"4326" – for horizontal CRS "omitted for vertical CRS	A()	
CRS Source	CRSS	{2} for horizontal CRS {255} for vertical CRS	b11	{2} - EPSG {255} - Not Applicable
CRS Source Information	SCRI	omitted	A()	

B-5.1.11 Coordinate System Axes field - CSAX

This field is only used for vertical CRS.

Subfield name	Label	Value	Format	Comment
Axis Type	*AXTY	{12}	b11	{12} – Gravity related depth (orientation down)
Axis Unit of Measure	AXUM	{4}	b11	{4} - Metre

B-5.1.12 Vertical Datum field – VDAT

This field is only used for vertical CRS.

Subfield name	Label	Value	Format	Comment
Datum Name	DTNM		A()	Name of the enumeration value of the attribute VERDAT
Datum Identifier	DTID		A()	Enumeration value of the attribute VERDAT
Datum Source	DTSR	{2}	b11	{2} - Feature Catalogue
Datum Source Information	SCRI	omitted	A()	

B-5.1.13 Information Type Identifier field - IRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{150}	b11	{150} - Information Type
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Numeric Information Type Code	NITC		b12	A valid information type code as defined in the ITCS field of the Dataset General Information Record
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B-5.1.14 Attribute field - ATTR

Subfield name	Label	Value	Format	Comment
Numeric attribute code	*NATC		b12	A valid attribute code as defined in the ATCS field of the Dataset General Information Record
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within

				this ATTR field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN	{1}	b11	{1} - Insert
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B-5.1.15 Information Association field - INAS

Subfield name	Label	Value	Format	Subfield content and specification
Referenced Record name	*RRNM	150	b11	Record name of the referenced record {150} – Information Type
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Numeric Information Association Code	NIAC		b12	A valid code for the information association as defined in the IACS field of the Dataset General Information Record
Numeric AssociationRole code	NARC			A valid code for the role as defined in the ARCS field of the Dataset General Information Record
Information Association Update Instruction	IUIN		b11	{1} - Insert {2} – Delete {3} - Modify
Numeric attribute code	*NATC		b12	A valid attribute code as defined in the ATCS field of the Dataset General Information Record
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within this INAS field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B-5.1.16 Point Record Identifier field - PRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{110}	b11	{110} - Point
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} – Insert

B-5.1.17 2-D Integer Coordinate Tuple field structure – C2IT

Subfield name	Label	Value	Format	Comment
Coordinate in Y axis	*YCOO		b24	Y-coordinate (latitude)
Coordinate in X axis	XCOO		b24	X-coordinate (longitude)

B-5.1.18 3-D Integer Coordinate Tuple field structure– C3IT

Subfield name	Label	Value	Format	Comment
Vertical CRS Id	VCID		b11	Internal identifier of the Vertical CRS
Coordinate in Y axis	*YCOO		b24	Y- coordinate (latitude)
Coordinate in X axis	XCOO		b24	X- coordinate (longitude)
Coordinate in Z axis	ZCOO		b24	Z - coordinate (depth)

B-5.1.19 Multi Point Record Identifier field - MRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{115}	b11	{115} - Multi Point
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B-5.1.20 2-D Integer Coordinate List field structure – C2IL

Subfield name	Label	Value	Format	Subfield content and specification
Coordinate in Y axis	*YCOO		b24	Y-coordinate or latitude
Coordinate in X axis	XCOO		b24	X-coordinate or longitude

B-5.1.21 3-D Integer Coordinate List field structure – C3IL

Subfield name	Label	Format	Subfield content and specification
Vertical CRS Id	VCID	b11	Internal identifier of the Vertical CRS
Coordinate in Y axis	*YCOO	b24	Y- coordinate or latitude
Coordinate in X axis	XCOO	b24	X- coordinate or longitude
Coordinate in Z axis	ZCOO	b24	Z - coordinate (depth or height)

B-5.1.22 Curve Record Identifier field - CRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{120}	b11	{120} - Curve
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B-5.1.23 Point Association field - PTAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Topology indicator	TOPI		b11	{1} - Beginning point {2} - End point {3} - Beginning & End point

B-5.1.24 Segment Header field - SEGH

Subfield name	Label	Value	Format	Comment
Interpolation	INTP	{4}	b11	{4} - Loxodromic
Circle or arc	CIRC	{255}	b11	omitted
Coordinate in Y axis	YCOO		b48	omitted
Coordinate in X axis	XCOO		b48	omitted
Distance	DIST		b48	omitted
Distance unit	DISU	{255}	b11	omitted
Start Bearing Angle	SBRG		b48	omitted
Angular distance	ANGL		b48	omitted

B-5.1.25 Composite Curve Record Identifier field - CCID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{125}	b11	{125} - Composite Curve
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B-5.1.26 Curve Component field - CUCO

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} - Forward {2} - Reverse

B-5.1.27 Surface Record Identifier field - SRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{130}	b11	{130} - Surface
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} – Insert

B-5.1.28 Ring Association field - RIAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} - Forward {2} - Reverse
Usage indicator	USAG		b11	{1} - Exterior {2} - Interior
Ring Association update instruction	RAUI	{1}	b11	{1} – Insert

B-5.1.29 Feature Type Record Identifier field - FRID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{100}	b11	{100} - Feature type
Record identification number	RCID		b14	Range: 1 to 2^{32}-2
Numeric Feature Type Code	NFTC		b12	A valid feature type code as defined in the FTCS field of the Dataset General Information Record
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B-5.1.30 Feature Object Identifier field - FOID

Subfield name	Label	Value	Format	Comment
Producing agency	AGEN		b12	Agency code
Feature identification number	FIDN		b14	Range: 1 to 2^{32}-2
Feature identification subdivision	FIDS		b12	Range: 1 to 2^{16}-2

B-5.1.31 Spatial Association field - SPAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM	One of {110} {115} {120} {125} {130}	b11	Record name of the referenced record {110} – Point {115} – Multi Point {120} – Curve {125} – Composite Curve {130} – Surface
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} Forward {2} Reverse {255} NULL (Not Applicable)
Scale Minimum	SMIN		b14	Denominator of the largest scale for which the feature type can be depicted by the referenced spatial feature. If the value is 0 it does not apply.
Scale Maximum	SMAX		b14	Denominator of the smallest scale for which the feature type can be depicted by the referenced spatial feature. If the value is 2^{32}-1 it does not apply.
Spatial Association Update Instruction	SAUI	{1}	b11	{1} - Insert

B-5.1.32 Feature Association field – FASC

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM	{100}	b11	Record name of the referenced record {100} – Feature Type
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Numeric Feature Association Code	NFAC		b12	A valid code for the feature association as defined in the FACS field of the Dataset General Information Record
Numeric AssociationRole Code	NARC		b12	A valid code for the role as defined in the ARCS field of the Dataset General Information Record
Feature Association Update Instruction	FAUI	{1}	b11	{1} - Insert
Numeric Attribute Code	*NATC		b12	A valid attribute code as defined in the ATCS field of the Dataset General Information Record
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within this FASC field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B-5.1.33 Masked Spatial Type field - MASK

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM	{120} or {125}	b11	Record name of the referenced record {120} – Curve {125} – Composite Curve
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Mask Indicator	MIND	{1} or {2}	b11	{1} – Truncated by the dataset limit {2} – Supress portrayal
Mask Update Instruction	MUIN	{1}	b11	{1} - Insert

B-6 Update dataset structure

```
Update dataset file
    |
    |--<1>- Dataset General Information record
    |    |
    |    |--<1>-DSID (13\\*1): Dataset Identification field
    |    |
    |    |--<1>-DSSI (13): Dataset Structure Information field
    |         |
    |         |--<0..1>-ATCS (*2): Attribute Codes field
    |         |
    |         |--<0..1>-ITCS (*2): Information Type Codes field
    |         |
    |         |--<0..1>-FTCS (*2): Feature Type Codes field
    |         |
    |         |--<0..1>-IACS (*2): Information Association Codes field
    |         |
    |         |-<0..1>-FACS (*2): Feature Association Codes field
    |         |
    |         |-<0..1>-ARCS (*2): Association Role Codes field
    |
    |
    |--<0..*>--Information record
    |    |
    |    |--<1>-IRID (5): Information Type Record Identifier field
    |       |
    |       |--<0..*>- ATTR (*5): Attribute field
    |       |
    |       |--<0..*>- INAS (5\\*5): Information Association field
    |
    |
    |--<0..*>-- Point record
    |    |
    |    |--<1>-PRID (4): Point Record Identifier field
    |       |
    |       |-<0..*>-INAS (5\\*5): Information Association field
    |       |
    |       | alternate coordinate representations
    |       |
    |       *-<1>-C2IT (2): 2-D Integer Coordinate Tuple field
    |       |
    |       *-<1>-C3IT (4): 3-D Integer Coordinate Tuple field
    |
    |
    |--<0..*>-- Multi Point record
    |    |
    |    |--<1>-MRID (4): Multi Point Record Identifier field
    |       |
    |       |-<0..*>-INAS (5\\*5): Information Association field
    |       |
    |       |-<0..1>-COCC (3): Coordinate Control field
    |       |
    |       | alternate coordinate representations
    |       |
    |       *-<0..*>-C2IL (*2): 2-D Integer Coordinate List field
    |       |
    |       *-<0..*>-C3IL (1\\*3): 3-D Integer Coordinate List field
    |
    |
```

```
|--<0..*>-- Curve record
|   |
|   |--<1>-CRID (4): Curve Record Identifier field
|      |
|      |-<0..*>-INAS (5\\*5): Information Association field
|      |
|      |-<1>-PTAS (*3): Point Association field
|      |
|      |-<0..1>-SECC (3): Segment Control field
|      |
|      |-<1>-SEGH (1): Segment Header field
|          |
|          |-<0..1>-COCC (3): Coordinate Control Field
|          |
|          |-<01..*>-C2IL (*2): 2-D Integer Coordinate List field
|
|
|--<0..*>-- Composite Curve record
|   |
|   |--<1>-CCID (4): Composite Curve Record Identifier field
|      |
|      |-<0..*>-INAS (5\\*5): Information Association field
|      |
|      |-<0..1>-CCOC (3): Curve Component Control field
|      |
|      |-<0..*>-CUCO (*3): Curve Component field
|
|
|--<0..*>-- Surface record
|   |
|   |--<1>-SRID (4): Surface Record Identifier field
|      |
|      |-<0..*>-INAS (5\\*5): Information Association field
|      |
|      |-<1..*>-RIAS (*5): Ring Association Field
|
|
|--<0..*>-- Feature Type record
    |
    |--<1>-FRID (5): Feature Type Record Identifier field
       |
       |-<0..1>-FOID (3): Feature Object Identifier field
       |
       |-<0..*>-ATTR (*5): Attribute field
       |
       |-<0..*>-INAS (5\\*5): Information Association field
       |
       |-<0..*>-SPAS (*6): Spatial Association field
       |
       |-<0..*>-FASC (*5): Feature Association field
       |
       |-<0..*>-MASK (*4): Masked Spatial Type field
```

B6.1 Field Content

B6.1.1 Dataset Identification field - DSID

Subfield name	Label	Value	Format	Comment
Record nName	RCNM	{10}	b11	{10} - Dataset Identification
Record iidentification number	RCID	{1}	b14	Only one record
Encoding sSpecification	ENSP	'S-100 Part 10a'	A()	Encoding specification that defines the encoding
Encoding sSpecification eEdition	ENED	"1.1"	A()	Edition of the encoding specification
Product iidentifier	PRSP	"INT.IHO.S-101.1.0"	A()	Unique identifier for the data product as specified in the Pproduct Sspecification
Product eEdition	PRED	"1.0"	A()	Edition of the Pproduct Sspecification
Application pProfile	PROF	"2"	A()	"2" – Update dataset profile
Dataset fFile iidentifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset tTitle	DSTL		A()	The title of the dataset
Dataset rReference dDate	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset lLanguage	DSLG	"EN"	A()	The (primary) language used in this dataset
Dataset aAbstract	DSAB	omitted	A()	The abstract of the dataset
Dataset eEdition	DSED		A()	[edition number].[update number] for example 4.20
Dataset tTopic cCategory	*DSTC	{14}{18}	b11	A set of topic categories

B6.1.2 Dataset Structure Information field - DSSI

Subfield name	Label	Value	Format	Comment
Dataset Coordinate Origin X	DCOX	{0.0}	b48	Shift used to adjust x-coordinate before encoding
Dataset Coordinate Origin Y	DCOY	{0.0}	b48	Shift used to adjust y-coordinate before encoding
Dataset Coordinate Origin Z	DCOZ	{0.0}	b48	Shift used to adjust z-coordinate before encoding
Coordinate Multiplication Factor for X-coordinate	CMFX	$\{10^7\}$	b14	Floating point to integer multiplication factor for the x-coordinate or longitude
Coordinate Multiplication Factor for Y-coordinate	CMFY	$\{10^7\}$	b14	Floating point to integer multiplication factor for the y-coordinate or latitude
Coordinate Multiplication Factor for Z-coordinate	CMFZ	{100}	b14	Floating point to integer multiplication factor for the z-coordinate or depths or height
Number of Information Type Records	NOIR		b14	Number of information records in the dataset
Number of Point records	NOPN		b14	Number of point records in the dataset
Number of Multi Point records	NOMN		b14	Number of multi point records in the dataset
Number of Curve records	NOCN		b14	Number of curve records in the dataset
Number of Composite Curve records	NOXN		b14	Number of composite curve records in the dataset
Number of Surface records	NOSN		b14	Number of surface records in the dataset
Number of Feature Type Records	NOFR		b14	Number of feature records in the dataset

B6.1.3 Attribute Code field structure - ATCS

Subfield name	Label	Value	Format	Comment
Attribute Code	ATCD		A	The code as defined in the Ffeature Ccatalogue
Attribute Numeric Code	ANCD		b12	The code used within the NATC subfield

B6.1.4 Information Type Codes field structure - ITCS

Subfield name	Label	Value	Format	Comment
Information Type Code	ITCD		A	The code as defined in the Ffeature Ccatalogue
Information Type Numeric Code	ITNC		b12	The code used within the NITC subfield

B6.1.5 Feature Type Codes field structure - FTCS

Subfield name	Label	Value	Format	Comment
Feature Type Code	FTCD		A	The code as defined in the Ffeature Ccatalogue
Feature Type Numeric Code	FTNC		b12	The code used within the NFTC subfield

B6.1.6 Information Association Codes field structure - IACS

Subfield name	Label	Value	Format	Comment
Information Association Code	IACD		A	The code as defined in the Ffeature Ccatalogue
Information Association Numeric Code	IANC		b12	The code used within the NIAC subfield

B6.1.7 Feature Association Codes field structure - FACS

Subfield name	Label	Value	Format	Comment
Feature Association Code	FACD		A	The code as defined in the Ffeature Ccatalogue
Feature Association Numeric Code	FANC		b12	The code used within the NFAC subfield

B5.1.8 Association Role Codes field structure - ARCS

Subfield name	Label	Value	Format	Comment
Association Role Code	ARCD		A	The code as defined in the Ffeature Ccatalogue
Association Role Numeric Code	ARNC		b12	The code used within the NARC subfield

B6.1.9 Information Type Identifier field - IRID

Subfield name	Label	Value	Format	Comment
Record nName	RCNM	{150}	b11	{150} - Information Type
Record iidentification number	RCID		b14	Range: 1 to 2^{32}-2
Numeric iinformation Type Code	NITC		b12	A valid information type code as defined in the ITCS field of the Dataset General Information Record
Record vVersion	RVER		b12	RVER contains the serial number of the record edition
Record uUpdate iinstruction	RUIN	{1},{2} or {3}	b11	{1} – Insert {2} - Delete {3} - Modify

B6.1.10 Attribute field - ATTR

Subfield name	Label	Value	Format	Comment
Numeric aAttribute cCode	*NATC		b12	A valid attribute code as defined in the ATCS field of the Dataset General Information Record
Attribute iIndex	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1)
Parent iIndex	PAIX		b12	Index (position) of the parent complex attribute within this ATTR field (starting with 1). If the attribute has no parent (top level attribute) the value is 0
Attribute iInstruction	ATIN	{1}, {2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Attribute vValue	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above

B6.1.11 Information Association field - INAS

Subfield name	Label	Value	Format	Subfield content and specification
Referenced Record nName	RRNM		b11	Record name of the referenced record
Referenced Record iIdentifier	RRID		b14	Record identifier of the referenced record
Numeric Information Association Code	NIAC		b12	A valid code for the information association as defined in the IACS field of the Dataset General Information Record
Numeric Association Role Code	NARC		b12	A valid code for the role as defined in the ARCS field of the Dataset General Information Record
Information Association Update Instruction	IUIN		b11	{1} - Insert {2} – Delete {3} - Modify
Numeric Attribute Code	*NATC		b12	A valid attribute code as defined in the ATCS field of the Dataset General Information Record
Attribute iIndex	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1)
Parent iIndex	PAIX		b12	Index (position) of the parent complex attribute within this ATTR field (starting with 1). If the attribute has no parent (top level attribute) the value is 0
Attribute iInstruction	ATIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute vValue	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above

B6.1.12 Point Record Identifier field - PRID

Subfield name	Label	Value	Format	Comment
Record nName	RCNM	{110}	b11	{110} - Point
Record iIdentification number	RCID		b14	Range: 1 to 2^{32}-2
Record vVersion	RVER		b12	RVER contains the serial number of the record edition
Record uUpdate iInstruction	RUIN	{1},{2} or {3}	b11	{1} – Insert {2} - Delete {3} - Modify

B6.1.13 2-D Integer Coordinate Tuple field structure - C2IT

Subfield name	Label	Value	Format	Comment
Coordinate in Y axis	YCOO		b24	Y-coordinate or latitude
Coordinate in X axis	XCOO		b24	X-coordinate or longitude

B6.1.14 3-D Integer Coordinate Tuple field structure - C3DI

Subfield name	Label	Value	Format	Comment
Vertical CRS Id	VCID		b11	Internal identifier of the Vertical CRS
Coordinate in Y axis	YCOO		b24	Y- coordinate or latitude
Coordinate in X axis	XCOO		b24	X- coordinate or longitude
Coordinate in Z axis	ZCOO		b24	Z - coordinate (depth)

B6.1.15 Multi Point Record Identifier field - MRID

Subfield name	Label	Value	Format	Comment
Record n~~N~~ame	RCNM	{115}	b11	{115} - Multi Point
Record i~~i~~dentification number	RCID		b14	Range: 1 to 2^{32}-2
Record v~~V~~ersion	RVER		b12	RVER contains the serial number of the record edition
Record u~~U~~pdate i~~i~~nstruction	RUIN	{1},{2} or {3}	b11	{1} – Insert {2} - Delete {3} - Modify

B6.1.16 2-D Integer Coordinate List field structure - C2IL

Subfield name	Label	Format	Subfield content and specification
Coordinate in Y axis	*YCOO	b24	Y-coordinate or latitude
Coordinate in X axis	XCOO	b24	X-coordinate or longitude

B6.1.17 3-D Integer Coordinate List field structure - C3IL

Subfield name	Label	Format	Subfield content and specification
Vertical CRS Id	VCID	b11	Internal identifier of the Vertical CRS
Coordinate in Y axis	*YCOO	b24	Y- coordinate or latitude
Coordinate in X axis	XCOO	b24	X- coordinate or longitude
Coordinate in Z axis	ZCOO	b24	Z - coordinate (depth)

B6.1.18 Coordinate Control field - COCC

Subfield name	Label	Value	Format	Comment
Coordinate Update Instruction	COUI	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Coordinate Index	COIX		b12	Index (position) of the addressed coordinate tuple within the coordinate field(s) of the target record
Number of Coordinates	NCOR		b12	Number of coordinate tuples in the coordinate field(s) of the update record

B6.1.19 Curve Record Identifier field - CRID

Subfield name	Label	Value	Format	Comment
Record Name	RCNM	{120}	b11	{120} - Curve
Record Identification number	RCID		b14	Range: 1 to 2^{32}-2
Record Version	RVER		b12	RVER contains the serial number of the record edition
Record Update Instruction	RUIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B6.1.20 Point Association field - PTAS

Subfield name	Label	Value	Format	Comment
Referenced Record nName	*RRNM		b11	Record name of the referenced record
Referenced Record iIdentifier	RRID		b14	Record identifier of the referenced record
Topology iIndicator	TOPI		b11	{1} - Beginning point {2} - End point {3} - Beginning & End point

B6.1.21 Segment Control field - SECC

Subfield name	Label	Value	Format	Comment
Segment uUpdate iInstruction	SEUI	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Segment iIndex	SEIX		b12	Index (position) of the addressed segment in the target record
Number of sSegments	NSEG		b12	Number of segments in the update record

B6.1.22 Segment Header field - SEGH

Subfield name	Label	Value	Format	Comment
Interpolation	INTP	{4}	b11	{4} - Loxodromic

B6.1.23 Composite Curve Record Identifier field - CCID

Subfield name	Label	Value	Format	Comment
Record nName	RCNM	{125}	b11	{125} - Composite Curve
Record iIdentification number	RCID		b14	Range: 1 to 2^{32}-2
Record vVersion	RVER		b12	RVER contains the serial number of the record edition
Record uUpdate iInstruction	RUIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B6.1.24 Curve Component Control field - CCOC

Subfield name	Label	Value	Format	Comment
Curve Component uUpdate iInstruction	CCUI		b11	{1} - Insert {2} - Delete {3} - Modify
Curve Component iIndex	CCIX		b12	Index (position) of the addressed Curve record pointer within the CUCO field(s) of the target record
Number of Curve Components	NCCO		b12	Number of Curve record pointer in the CUCO field(s) of the update record

B6.1.25 Curve Component field - CUCO

Subfield name	Label	Value	Format	Comment
Referenced Record nName	*RRNM	{120} or {125}	b11	Record name of the referenced record {120} – Curve {125} – Composite Curve
Referenced Record iIdentifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} - Forward {2} - Reverse

B6.1.26 Surface Record Identifier field - SRID

Subfield name	Label	Value	Format	Comment
Record nName	RCNM	{130}	b11	{130} - Surface
Record iIdentification number	RCID		b14	Range: 1 to 2^{32}-2
Record vVersion	RVER		b12	RVER contains the serial number of the record edition
Record uUpdate iInstruction	RUIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B6.1.27 Ring Association field - RIAS

Subfield name	Label	Value	Format	Comment
Referenced Record nName	*RRNM	{120} or {125}	b11	Record name of the referenced record {120} – Curve {125} – Composite Curve
Referenced Record iIdentifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} - Forward {2} - Reverse
Usage indicator	USAG		b11	{1} - Exterior {2} - Interior
Ring Association uUpdate iInstruction	RAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

B6.1.28 Feature Type Record Identifier field - FRID

Subfield name	Label	Value	Format	Comment
Record nName	RCNM	{100}	b11	{100} - Feature type
Record iIdentification number	RCID		b14	Range: 1 to 2^{32}-2

Numeric Feature Type Code	NFTC		b12	A valid feature type code as defined in the FTCS field of the Dataset General Information Record
Record vVersion	RVER		b12	RVER contains the serial number of the record edition
Record uUpdate iInstruction	RUIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B6.1.29 Feature Object Identifier field - FOID

Subfield name	Label	Value	Format	Comment
Producing aAgency	AGEN		b12	Agency code
Feature iIdentification nNumber	FIDN		b14	Range: 1 to 2^{32}-2
Feature iIdentification SSubdivision	FIDS		b12	Range: 1 to 2^{16}-2

B6.1.30 Spatial Association field - SPAS

Subfield name	Label	Value	Format	Comment
Referenced Record nName	*RRNM	{1} to {5}	b11	Record name of the referenced record {1} - 110 {2} - 115 {3} - 120 {4} - 125 {5} - 130
Referenced Record iIdentifier	RRID		b14	Record identifier of the referenced record
Orientation	ORNT		b11	{1} Forward {2} Reverse {255} NULL (Not Applicable)
Scale Minimum	SMIN		b14	Denominator of the largest scale for which the feature type can be depicted by the referenced spatial feature. If the value is 0 it does not apply
Scale Maximum	SMAX		b14	Denominator of the smallest scale for which the feature type can be depicted by the referenced spatial feature. If the value is 2^{32}-1 it does not apply
Spatial Association uUpdate iInstruction	SAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

NOTE: For a correct handling of older data, robust parsers should consider both 0 and 2^{32}-1 as 'Not Applicable' for the SMIN and the SMAX sub-field.

B6.1.31 Feature Association field – FASC

Subfield name	Label	Value	Format	Comment
Referenced Record nName	RRNM		b11	Record name of the referenced record
Referenced Record iIdentifier	RRID		b14	Record identifier of the referenced record
Numeric Feature Association Code	NFAC		b12	A valid code for the feature association as defined in the FACS field of the Dataset General Information Record
Numeric Association Role Code	NARC		b12	A valid code for the role as defined in the ARCS field of the Dataset General Information Record
Feature Association Update Instruction	FAUI	{1} ,{2} or {3}	b11	{1} - Insert {2} – Delete {3} - Modify
Numeric Attribute Code	*NATC		b12	A valid attribute code as defined in the ATCS field of the Dataset General Information Record
Attribute iIndex	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1)
Parent iIndex	PAIX		b12	Index (position) of the parent complex attribute within this ATTR field (starting with 1). If the attribute has no parent (top level attribute) the value is 0
Attribute iInstruction	ATIN	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Attribute vValue	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above

B6.1.32 Masked Spatial Type field - MASK

Subfield name	Label	Value	Format	Comment
Referenced Record nName	*RRNM	{120} or {125}	b11	Record name of the referenced record {120} – Curve {125} – Composite Curve
Referenced Record iIdentifier	RRID		b14	Record identifier of the referenced record
Mask Indicator	MIND	{1} or {2}	b11	{1} - Truncated by the dataset limit {2} - Supress portrayal
Mask uUpdate iInstruction	MUIN	{1} or {2}	b11	{1} - Insert {2} - Delete

B-7 Dataset cancellation structure

```
Dataset cancelation file
   |
   |--<1>- Dataset General Information record
       |
       |--<1>-DSID (13\\*1): Dataset Identification field
```

B-7.1.1 Field Content

B-7.1.2 Dataset Identification field - DSID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{10}	b11	{10} - Dataset Identification

Record identification number	RCID	{1}	b14	Only one record
Encoding specification	ENSP	'S-100 Part 10a'	A()	Encoding specification that defines the encoding
Encoding specification edition	ENED	"1.1"	A()	Edition of the encoding specification
Product identifier	PRSP	"IEHG.S-401.1.0"	A()	Unique identifier for the data product as specified in the Pproduct Sspecification
Product edition	PRED	"1.0"	A()	Edition of the Pproduct Sspecification
Application profile	PROF	"2"	A()	"2" – ER Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLG	"EN"	A()	The (primary) language used in this dataset
Dataset abstract	DSAB	omitted	A()	The abstract of the dataset
Dataset edition	DSED	"0"	A()	0 - indicates the cancelation
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

ANNEX C - S-401 Validation Checks

The validation checks specific to S-401 ENC datasets are included in IHO Publication S-158:101. This documentThis Annex specifies the minimum checks that producers of S-401 IENC validation tools should include in their validation software. This software must be used by hydrographic offices to help ensure that their IENC data are compliant with the S-401 IENC Product Specification. The checklist has been compiled for the IHO from lists of checks provided by a number of hydrographic offices and software companies. The Annex XXXXXXXprovides checks for individual IENC cells however additional checks applicable to IENC Exchange Sets are included in part X.X.

The S-401 Validation Checks can be found in the Standards and Publications page of the IEHG web site, ienc.openecdis.org

Kommentiert [GM81]: In which publication are the S-401 validation checks described?

Kommentiert [BB82R81]: Register the number at IHO

Kommentiert [GM83]: Refer to the publication

Annex C – S-52 Checklist

<<NOTE: This Annex contains clauses taken directly from S-52. They are currently here as a checklist until the portrayal catalogue has been built and the S-100 concepts that map to the S-52 concepts have been incorporated into the main body of S-101 and to ensure that certain functionality that is needed for ECDIS is not lost. >>