S-101

IHO Electronic Navigational Chart (ENC) Product Specification

Edition 1.1.0.20221025 – Xxxx 2022

IHO

International Hydrographic Organization

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International Hydrographic Organization
4b quai Antoine 1er
Principauté de Monaco
Tel: (377) 93.10.81.00
Fax: (377) 93.10.81.40
info@iho.int
www.iho.int

Contents

Document History

Changes to this Specification are coordinated by the 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 IHO web site. Maintenance of the Specification shall conform to IHO Resolution 2/2007 (as amended).

Version Number	Date	Approved By	Purpose
Phase 1	May 2009	J. Powell	Initial Draft.
Phase 1	June 2010	J. Powell	Merged all the phases back into a single document.
Phase 1	July 2010	J. Powell	Added comments from AHO.
Phase 1	September	J. Powell	Revised based on FG discussions.
Phase 1	December 2010	J. Powell	Revised based on TSMAD 21.
Phase 1	February 2011	J.Powell	Revised based on comments to phase 1 from 2J, FR, AU.
Phase 2	April 2011	J.Powell	Revised based on comments from TSMAD22. Changed version to 0.1.0 to reflect movement to phase 2.
Phase 2	November 2011	J.Powell	Revisions made based on comments from discussion papers circulated post TSMAD 22.
Phase 3	February	J.Powell	Revisions made based on TSMAD23 decisions.
Phase 3	May 2012	J.Powell	Added TSMAD24 Decisions into document.
Phase 4	August 2012	J.Powell	Edited document to reflect TSMAD24 decisions.
Phase 4	November 2012	J.Powell	Added comments from October 2012 round of TSMAD comments.
Initial Draft	March 2013	J.Powell	Added comments from January 2013 round of TSMAD comments.
Initial Draft	June 2013	J.Powell	Added decisions from TSMAD26.
Initial Draft	December 2013	J.Powell	Added in decisions from TSMAD27.
Draft 0.0.0	April/May 2014	S-100WG	Included S-101 portrayal. Most of the portrayal is covered by the catalogue, so much of the old S-52 guidance goes into the implementation guidance annex.
Draft 0.0.1	February 2015	S-100WG	Added adjudicated comments from TSMAD29.
Draft 0.0.2	January 2016	S-100WG	Incorporated editorial issues that were noted in draft 0.0.1. Also includes a revised metadata section.
Draft 0.0.2	July 2017	S-100WG	Incorporated the decisions from S101PT1 and updated some editorial issues. Numbering remained the same to be consistent with the DCEG numbering.
Draft 1.0.0	October 2018	S-100WG	Editorial S-101PT review and clean-up in preparation for final approval to publish as Edition 1.0.0.
Draft 1.1.0	May 2022	S-100WG	New version for implementation and testing, updated to align with S-100 Edition 5.0.0.

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Introduction

S-101 is the Electronic Navigational Chart (ENC) Product Specification, produced by the International Hydrographic Organization. S-101 is designed to allow content, content definition (Feature Catalogues) and presentation (Portrayal Catalogues) to be updateable as "Plug and Play" system implementations

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Based on the IHO Universal Hydrographic Data Model S-100, S-101 includes all the necessary components for both Hydrographic Offices to produce Electronic Navigational Charts (ENCs); and marine navigation systems (principally Electronic Chart Display and Information Systems (ECDIS)) 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.

1 Overview

1.1 Scope

This document describes an S-100 compliant Product Specification for Electronic Navigational Charts, which will form the base navigation layer for an S-100 based marine navigation system. It specifies the content, structure, and metadata needed for creating a fully compliant S-101 ENC and for its portrayal within an S-100 system. This Product Specification includes the content model, the encoding, the Feature Catalogue, Portrayal Catalogue, metadata, and 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*, Edition 5.0.0
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*

Commented [JW1]: UK: Conversion of S-57 to S-101 is a major (initial) consideration for HO when implementing S-101 coverage. Add to references: S-65 Annex B S-57 ENC to S-101 Conversion Guidance.

IHO Sec: **Not applied.** The References section is intended to list the references that have been utilized in developing the document, not additional references relevant to S-101. Perhaps there should be a sub-clause somewhere in S-101 (DCEG)?

Commented [JW2]: PRIMAR: S-52 latest updates are Dec 2020. "… with Clarifications up to December 2020".

IHO Sec: **Not applied.** S-52 Edition 6.1(,1) is updated with Clarifications to June 2015. It is the PL (4.0(.3)) that is updated to December 2020.

Deleted: 4

1.3 Terms, definitions and abbreviations

1.3.1 Use of language

Within this document:

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

1.3.2 Terms and definitions

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

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

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 ship.

Alert
(MSC.302/A) announcement of abnormal situations and conditions requiring attention. Alerts are divided in four priorities: **emergency alarm**s, **alarm**s, **warning**s and **caution**s. 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 the 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 semantics.

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**.

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

Commented [JW3]: NIWC: Recommend remove (or update).
- Applies to drawing instructions, not features
- A feature can have multiple drawing instructions, each with different priorities.
- The hierarchy only applies within a display plane – the display planes form their own hierarchy.

IHO Sec: To be discussed. Suggest that the definition should be updated.

Commented [JW4]: NIWC: I believe term “SENC” has been proposed to be dropped. See IMO NCSR 9/WP.6 See page 4

PRIMAR [For “ECDIS”, “Radar Priority”, “SENC” and “throughout document”]: Replace SENC with System database? Or considered too early for 1.1.0 version?

IHO Sec: To be discussed.

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 for both familiarization with ECDIS and to look up specific symbols.

Emergency Alarm
(MSC.302/A) highest priority of an **alert**. A condition presenting an immediate danger to human life or to the ship 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 conforming 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.

Enumeration
A fixed list of valid identifiers of named literal values. **Attributes** of an enumerated 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 as a feature instance 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
Geometric object representing a single, connected, homogeneous element of geometry.

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

Commented [JW5]: DE: Non-decomposed -> non-decomposable.

IHO Sec: **Not applied.** I think this definition and the Note Has been taken directly from ISO. TBC.

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.

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**.

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

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

Metadata
Data about data.

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

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)

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.

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 Mariners information clearly. However certain other information, 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 a feature is intended to be displayed (for example, a minor light, with a scale minimum of 1:45,000, would not normally be displayed at a scale of 1:90,000).

SENC
In **ECDIS** means a database, in the manufacturer's internal ECDIS format, resulting from the loss-less transformation of the entire **ENC** contents and its updates. It is this database that is accessed by ECDIS for the display generation and other navigational functions, and is at least equivalent to an up-to-date

Commented [JW6]: Christian review 11/07/22: Scale definitions aligned with S-100 5.0.0 as agreed at Scales Sub-Group meeting (26 November 2021).
Not sure it is the best one as a dataset can be displayed at a scale larger than MaxDS (possibly with overscale indication) or smaller than the MinDS if no smaller scale dataset is available. See https://github.com/iho-ohi/S-101-Documentation-and-FC/issues/11

Commented [JW7]: IHO Sec.

Commented [JW8]: NIWC: "intended" because the data can be displayed outside of it's scale band in some circumstances, such as filling in empty areas of the chart window.

GB: The ownness is on the data producer to determine the MaxDS. **Maximum Display Scale:** The maximum display scale with which the data producer had intended the data to be displayed.

IHO Sec: **Not applied.** Consider that this has been covered by added the "intended" phrase.

AU: Definition of Maximum and Minimum Display scale need more work. Some suggestions for discussion:
maxDScale *– Optimum ratio between the level of detail and the accuracy of the information provided. It is the recommended maximum MSVS for the data coverage.*
minDScale *– Recommended smallest MSVS for the data coverage due to an elevated possibility of data cluttering and reduced data clarity and readability.*

IHO Sec: **Not applied.** To be addressed in conjunction with ENC Scales and Data Load/Unload Sub-Group discussions.

Deleted: 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.

Commented [JW9]: IHO Sec.

Commented [JW10]: NIWC: "intended" because the data can be displayed outside of it's scale band in some circumstances, such as filling in empty areas of the chart window.

Deleted: 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.

Commented [JW11]: NIWC: See S-52 PresLib 10.1.10.1 Overscale Indication: *This overscale indication is required by IMO PS [3] whenever the display scale exceeds the compilation scale.*

IHO Sec: **Not applied.** To be addressed in conjunction with ENC Scales and Data Load/Unload Sub-Group discussions.

Commented [JW12]: NIWC: Recommends delete these entries.

IHO Sec: What is the justification for this proposal?

Commented [JW13]: NIWC: Can be overridden via "Ignore SCAMIN" context parameter.

Commented [JW14]: NIWC: See comment above regarding SENC. Amend "SENC" to "System Electronic Navigational Chart".

paper chart. The SENC may also contain information added by the mariner and information from other sources.

Skin of the Earth
A defined set of non-overlapping geographic features of geometric primitive surface, completely 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.

Temporal Reference System
Reference system against which time is measured.

Text Label
A textual description of a **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.

Viewing Scale
The 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 of the **dataset**.

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

CRS	Coordinate Reference System
DCEG	Data Classification and Encoding Guide
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigational Chart
EPSG	European Petroleum Survey Group
GFM	General Feature Model
IEC	International Electrotechnical Commission
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization
MSVS	Mariners 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

Commented [JW15]: NIWC: Recommends delete these entries.

IHO Sec: What is the justification for this proposal?

Commented [JW16]: NIWC: Recommends delete these entries.

IHO Sec: What is the justification for this proposal?

Commented [CM17]: Definition agreed at meeting 26 November 2021.

NIWC: Viewing scale is not solely related to features or dataset content: "… linear dimensions ~~of features of a dataset~~ presented ~~on in~~ the display and the actual dimensions ~~of the features~~ represented ~~of the dataset~~."

IHO Sec: **Not applied.** To be addressed in conjunction with ENC Scales and Data Load/Unload Sub-Group discussions.

Deleted: ¶

Commented [JW18]: NIWC: See comment above regarding SENC.

S-101PT	S-101 Project Team
TIFF	Tagged Image File Format
UML	Unified Modelling Language
URL	Universal Resource Locator
XML	Extensible Markup Language

1.4 General S-101 data product description

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NOTE: This information contains general information about the data product.

Title: Electronic Navigational Chart

Abstract: An Electronic Navigational Chart (ENC) is a vector chart produced on the authority of a government authorized Hydrographic Office or other relevant government institution. Its primary purpose is for use within an Electronic Chart Display and Information System (ECDIS) to meet International Maritime Organization (IMO) and Safety of Life at Sea (SOLAS) chart carriage requirements; however it may also be used as the base dataset in other S-100 based marine navigation systems. The ENC contains an extraction of real world information necessary for the safe navigation of vessels.

Content: The Product Specification defines all requirements to which ENC 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 (DCEG) provides guidance on how data product content must be captured. (Annex A.)

Spatial Extent:

Description: Areas specific to marine navigation.
East Bounding Longitude: 180°
West Bounding Longitude: -180°
North Bounding Latitude: 90°
South Bounding Latitude: -90°

Purpose: The purpose of an ENC dataset is to provide official navigational data for navigation systems for the safe passage and route planning of vessels between destinations.

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 International Hydrographic Organization Electronic Navigational Chart Product Specification

S-100 Version: 5.0.0

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S-101 Version: 1.1.0

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Date: Xxxx 2022

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Language: English

Classification: Unclassified

Contact: International Hydrographic Organization
4b Quai Antoine 1er
B.P. 445

MC 98011 MONACO CEDEX
Telephone: +377 93 10 81 00
Fax: + 377 93 10 81 40
Email: info@iho.int

URL: www.iho.int

Identifier: S-101

Maintenance: Changes to the Product Specification S-101 are coordinated by the S-101 Project Team (S-101PT), a Project Team under the IHO S-100 Working Group (S-100WG), and must be made available via the IHO web site. Maintenance of the Product Specification must conform to IHO Resolution 2/2007, as amended.

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1.6 IHO Product Specification maintenance

1.6.1 Introduction

Changes to S-101 will be released by the IHO as a New Edition, revision, or clarification.

1.6.2 New Edition

New Editions of S-101 introduce significant changes. *New Editions* enable new concepts, such as the ability to support new functions or applications, or the introduction of new constructs or data types. *New Editions* are likely to have a significant impact on either existing users or future users of S-101. All cumulative *revisions* and *clarifications* must be included with the release of approved New Editions.

1.6.3 Revision

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Revisions are defined as substantive semantic changes to S-101. Typically, *revisions* will change S-101 to correct factual errors; or 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-101. All cumulative *clarifications* must be included with the release of approved revisions.

Deleted: corrections

Changes in a *revision* are minor and ensure backward compatibility with the previous versions within the same Edition. Newer revisions, for example, introduce new features and attributes. Within the same Edition, a dataset of one version could always be processed with a later version of the Feature and Portrayal Catalogues.

In most cases a new Feature Catalogue or Portrayal Catalogue will result in a *revision* of S-101.

1.6.4 Clarification

Clarifications are defined as non-substantive changes to S-101. 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-101.

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-101 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 Scope

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Scope ID: Global

Level: 006 - series

Level name: ENC 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: Electronic Navigational Chart

Alternate Title: ENC

Abstract: S-101 ENCs must be produced in accordance with the rules defined in the S-101 Product Specification. The S-101 Product Specification contains all the information necessary to enable Hydrographic Offices to produce a consistent ENC; and manufacturers to use that data efficiently within navigation systems.

Topic Category: Transportation (ISO 19115-1 MD_TopicCategoryCode 018)

Geographic Description: Areas specific to marine navigation

Spatial Resolution: An ENC dataset and **Data Coverage** features must carry a value for maximum display scale. Each **Data Coverage** feature must also carry a value for minimum display scale. Values must be taken from the following Table:

Table 3-1 – ENC Minimum Display and Maximum Display Scales

Scale
NULL (only allowed on minimum display scale where the maximum display scale = 10,000,000)
1:10,000,000
1:3,500,000
1:1,500,000
1:700,000
1:350,000
1:180,000
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

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

Language: English (Mandatory), other (Optional)

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

Commented [JW19]: PRIMAR: Add S-101 to ENC to avoid confusion with S-57 ENC (which normally is referred to as ENC).

IHO Sec: **To be discussed.** Not sure about this – and also if the alternate title is going to have S-101 added shouldn't this also be added to the title?

Commented [JW20]: PRIMAR: S-101 could be used both for human and machine readable purposes.
This could be emphasised in the abstract by replacing the word "efficiently" with "both, human and machine readable"

IHO Sec: **To be discussed.** If this change is to be made suggest that the text read "… use that data efficiently within both human and machine-readable navigation systems". Am a little concerned though that this may be interpreted that S-101 will be "locked in" for use in MASS when it may need to be a separate PS.

Commented [JW21]: NIWC: There are numerous proposed changes to this section that are based on the re-introduction of Optimum Display Scale – refer to NIWC track-changed document.

IHO Sec: **Not applied.** To be addressed in conjunction with ENC Scales and Data Load/Unload Sub-Group discussions.

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1) Unclassified;
2) Restricted;
3) Confidential;
4) Secret;
5) Top Secret;
6) Sensitive but Unclassified;
7) For Official Use Only;
8) Protected; or
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-101 ENC 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-101 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-101 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-101 Feature Catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in an ENC.

The S-101 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-101 Annex A – Data Classification and Encoding Guide, constitutes a human readable interpretation of the Feature Catalogue.

4.3.2 Feature types

Feature types provide descriptive attributes, and can optionally be associated with geometry which describes the features shape and position.

Further details of feature types can be found in Annex A – *Data Classification and Encoding Guide*, clause 2.1 and Sections 4-23.

4.3.2.1 Geographic

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

4.3.2.1.1 Skin of the Earth

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

Commented [JW22]: NIWC: Given that this is described in the DCEG, recommend removal of subsections. If the subsections are retained, they should agree with the descriptions provided in the DCEG.

IHO Sec: **To be discussed.** Agree that the detailed descriptions should be only in one document.

Commented [JW23]: Derived from NIWC – see NIWC track-changed document.

Deleted: principle

Commented [JW24]: NIWC: Recommend this information is moved to the DCEG and referenced from here if desired. These are classification/encoding requirements.

IHO Sec: **To be discussed.**

Unsurveyed Area

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

4.3.2.2 Metadata features

Metadata 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.

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

4.3.2.3 Cartographic

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

4.3.3 Feature relationships

A feature relationship links instances of one feature type with instances of the same or a different feature type. There are three types of defined feature relationships in S-101 as described in the following sub clauses.

4.3.3.1

4.3.3.2 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 **Archipelagic Sea Lane** feature. An association named **Caution Area Association** is used to relate the two features; roles are used to convey the meaning of the relationship.

Figure 4-1 – Feature association

4.3.3.3 Aggregation

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

EXAMPLE: An **Island Group** feature may be composed of multiple **Land Area** features to indicate the name of a group of islands.

Commented [TR25]: Changes to skin of the earth features have a consequential impact on conversion, although the modelling better reflects the real world reviewers are invited to comment on whether this improvement warrants the additional effort during conversion given that there is no obvious end user benefit.

JW 07/10/22: DCEG Sub-Group decision (05/10/22) is to remove DockArea and LockBasin from the Skin of the Earth.

DE: Answer to comment from Thomas Richardson: Changes in skin of the earth features are an additional difficulty in conversion. Especially in the dual fuel period the data will not represent reality optimally. However, with the UNSARE/Unsurveyed Area workaround it can be automated and should not cause problems once dual fuel is gone. Then the data should be reviewed and Unsurveyed Area features replaced where necessary.
This highlights the fundamental problem during dual fuel, that the best (easiest) way to deal with constant conversion from S-57 to S-101 or vice versa is to avoid feature classes and attributes that do not exist in one of the two standards. But this limits the data to the least common denominator and prevents S-101 data from using its full potential.

Deleted: Dock Area¶
Lock Basin ¶

Commented [JW26]: GB: S-101 model better represents the real world, e.g., Pontoon's float on depth areas, so pontoons should not be Skin of the Earth. This presents problems (time to correct) Conversion of S-57 to S-100 SoE features, however methods for removing Pontoons as SoE using CARIS are well advanced, and we do consider this a major problem.

IHO Sec: Not sure what this means (to be clarified). Is this suggesting that no change is proposed, or no change from S-57?

Commented [JW27]: NIWC: This concept is directly carried forward from S-57 and is inconsistent with S-100. Recommend replacing with information associations.

Commented [JW28]: NIWC: This describes an information type…

Commented [JW29]: NIWC: Rather than overriding attributes of the feature, it would be more in line with S-100 principles to use an association to the appropriate information object.

Commented [JW30]: NIWC: Although metadata features are described in the FC, the FC does not (currently) describe the relationships between meta features and the features to which the meta features apply.

Deleted: real

Commented [JW31]: NIWC: An information association is not a feature relationship.

IHO Sec: Agree. **Applied.**

Deleted: four

Moved down [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.¶

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Commented [TS33]: Figure needs to be reviewed to determine if any amendment is required for changes to associations introduced in S-100 Edition 5.0.0.

Deleted: 2

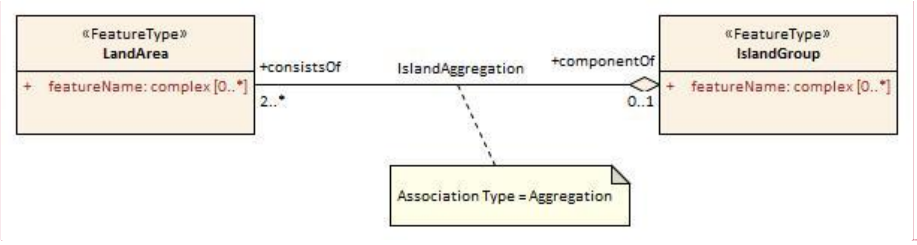


Figure 4-2 – Aggregation

Commented [TS34]: Figure needs to be reviewed to determine if any amendment is required for changes to associations introduced in S-100 Edition 5.0.0.

Deleted: 3

4.3.3.4 Composition

A composition is a strong aggregation. In a composition, if a container feature is deleted then all of its containee 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 4-4 – Composition

Commented [TS35]: Figure needs to be reviewed to determine if any amendment is required for changes to associations introduced in S-100 Edition 5.0.0.

4.3.4 Information types

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

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

Commented [JW36]: DE: All different kinds of information types should at least be mentioned. -> Contact Details, Service Hours, Non-Standard Working Day, Nautical Information, Spatial quality (see DCEG 24.1 – 24.5)

IHO Sec: Have chosen to only include references to the relevant clauses of the DCEG (as for earlier types). Perhaps there is an argument if this is accepted to remove clause 4.3.4.1? **To be discussed.**

4.3.4.1 Spatial quality

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 has been identified, therefore this is prohibited. Vertical uncertainty is prohibited for curves as this dimension is not supported by curves.

Commented [JW37]: NIWC: Recommends delete.

IHO Sec: **To be discussed in association with other comments for this clause.**

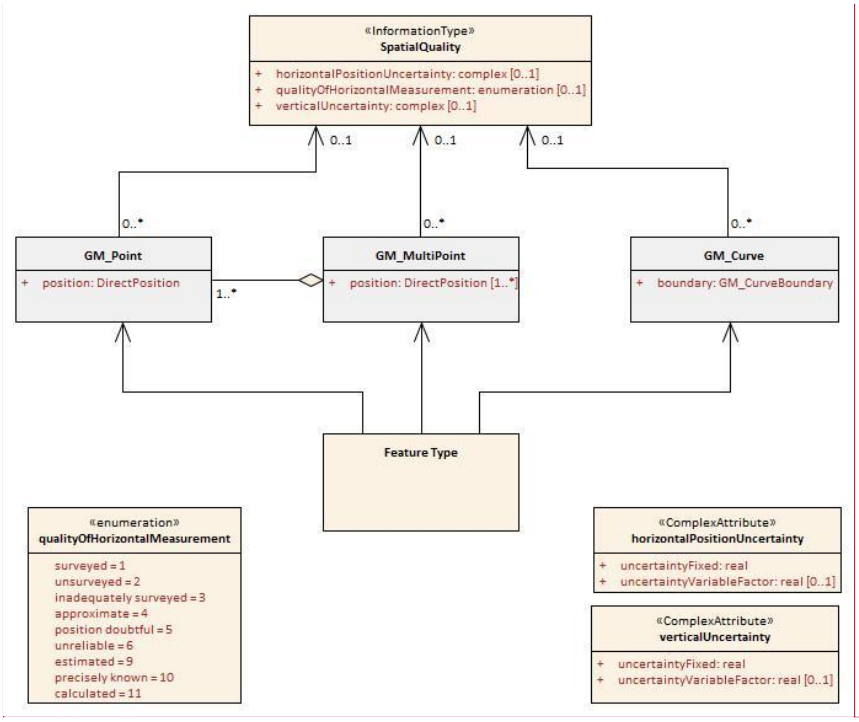


Figure 4-5 – Spatial Quality information type

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**.

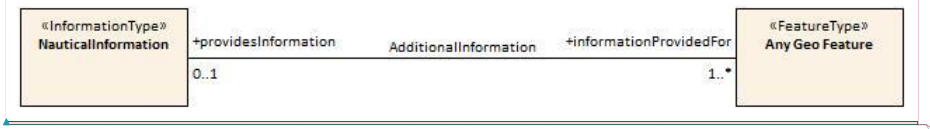


Figure 4-3 – Information association

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.

Commented [TS38]: This Figure needs to be updated to reflect the changes in the modelling of SpatialQuality introduced in DCEG Edition 1.0.2 (Raphael?).

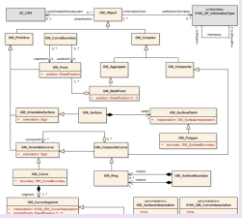
Commented [JW39]: DE: See DCEG 24.5. qualityOfHorizontalMeasurement: only values 4 and 5 are allowed.

IHO Sec: Agree – needs to be updated. However, as for above comment, does this need to be in 2 places? Suggest remove this clause altogether. **To be discussed.**

NIWC: This is inaccurate:

- The modelling of SpatialQuality has changed: add *spatialAccuracy*
- QoBD may have an association to SpatialQuality through QoBDComposition

The relationships shown here are simplifications of those described in S-100 5.0.0 Figure 7-3 Geometry:



IHO Sec: **To be discussed in association with other comments for this clause.** However, if this revised UML diagram is correct, suggest that it replace the current DCEG Figure 2.1.

Commented [JW40]: NIWC: See comments above for clause 4.3.3 and (former) 4.3.3.1. Suggested new clause "Information relationships".

IHO Sec: **To be confirmed.**

Commented [JW41]: NIWC: Moved from (former) clause 4.3.3.1.

IHO Sec: **To be confirmed.**

Moved (insertion) [1]

Commented [TS42]: Figure needs to be reviewed to determine if any amendment is required for changes to associations introduced in S-100 Edition 5.0.0.

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Commented [JW43]: NIWC: Suggested new clause "Information relationships".

IHO Sec: **To be confirmed.**

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.

4.3.6 Attributes

S-101 defines attributes as either simple or complex.

4.3.6.1 Simple attributes

S-101 uses seven types of simple attributes; they are listed in the following Table:

Table 4-1 – Simple attribute types

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
Free 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 dates to be provided
Time	the value is a 24 hour time, it may contain a time zone

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. Bindings of complex attributes may be represented in UML by a composition (Figure 4-6 below, left, *BuoyLateral/topmark* and *topmark/shapeInformation* compositions) or a local attribute (Figure 4-6, right, *BuoyCardinal* attributes *topmark* and *featureName*). S-101 uses the convention on the right.

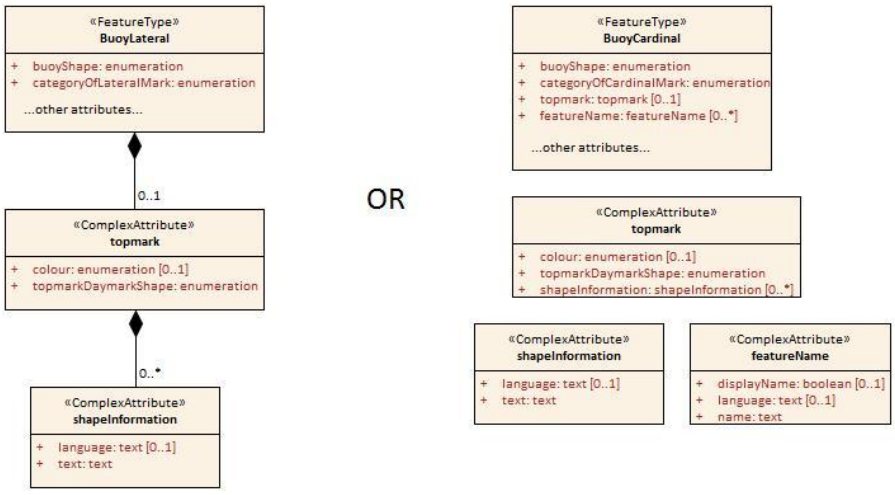

Figure 4-6 – Complex attribute

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

Commented [JW44]: NIWC: Recommend remove existing description and refer to S-100:
As written:
- precludes use of URI/URL/URN, dateTime, and code list
- Is simplistic – doesn't describe UOM, constraints, etc.

IHO Sec: Tend to agree,. However am not sure that Table 5-A-13 is the best reference. Attribute types are also described in clause 2.4.2 of the DCEG. Perhaps this should be referenced? **To be discussed.**

Deleted: 2

Commented [JW45]: DE: A side by side comparison of two ways to represent complex attributes is only useful if they both represent the same feature and its complex attributes. Otherwise the figure is just confusing. Differences in notation could well be caused by the different nature of the features and not by the way of representing the connections. Figure 4-6 feels like comparing apples to oranges.
Figure 4-6 should show different notations for the same feature and its complex attributes, not different features (even if they are similar).

IHO Sec: Tend to agree. **Raphael to supply updated UML?**

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**.

4.4 Feature Object Identifier

Each real world feature within an ENC 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 ENC 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 ENC dataset due to ENC dataset limit truncations, the feature will reference each spatial part of the feature within the dataset. This is accomplished in the ISO/IEC 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 multiple datasets of different maximum display scale, the FOID should be repeated for each instance of the feature. Where this occurs, all instances of the geo feature must be identical, that is same feature class and attribute values.

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 ENC data the geographic coverage of a given **maximum 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 ENC update dataset must not change the limit of a **Data Coverage** feature for the base ENC dataset. Where the limit of a **Data Coverage** feature for a base ENC dataset is to be changed, this must be done by issuing a New Edition of the dataset.

A dataset must not cross the 180° meridian.

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 base 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, continuous display scale ranges.

  [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 elaborate consistent S-101 ENC schemes carefully and try to avoid complex situations.

Commented [JW46]: NIWC: This is only available via the S-100 10a encoding and will be "hidden" within the SENC. It is not part of the S-100 GFM and will not be available to portrayal or through the pick report.

Recommend this is provided as an attribute.

IHO Sec: Needs a proposal. **To be discussed.**

Commented [JW47]: NIWC: Recommend ECDIS support for multiple geometries is tested in S-164.

IHO Sec: No action here for this document? **Needs to be discussed by the S-164 Sub-Group.**

Commented [JW48]: NIWC: Requirement can't be applied to features associated with MultiPoint geometries (Sounding and DepthNoBottomFound).

IHO Sec: Do not think this is an issue as sounding groups are simply a method of "compressing" the data and have no relationship to the "real world". **Suggest no action required.**

Deleted: across the maximum display scale range

Commented [JW49]: IHO Sec: Refer to NIWC track-changed version for full indication of suggested NIWC amendments to this Section. This requires full investigation and discussion by the S-101PT.

Refer also to GB submitted .ppt presentation outlining methodology behind suggested amendments to clauses 4.5 to 4.7.

Commented [JW50]: NIWC: Suggests removing this paragraph.

IHO Sec: Justification? Is there any harm in keeping this? **To be discussed.**

Commented [JW51]: Christian review 11/07/22: Further tests required to try and solve this issue in S-101.

Deleted: Datasets

Deleted: ; this includes both the **Data Coverage** features and the bounding box for the dataset

Commented [JW52]: NIWC: Suggests removing this bullet.

IHO Sec: Justification? Is there any harm in keeping this? **To be discussed.**

Commented [JW53]: NIWC: Redundant. Recommend delete.

IHO Sec: Why is this redundant? Is there any harm in keeping this? **To be discussed.**

Deleted: The

Deleted: within a

Deleted: not

Deleted: , however **Data Coverage** features from different datasets may overlap if they have differing maximum

Deleted: scales

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Commented [CM54]: Further guidance to be elaborated, and probably put in S-11.

Commented [JW55]: GB: Third Bullet point
•**Data Coverage** features from different datasets may overlap if they have differing maximum display scales.
Fourth Bullet point ...

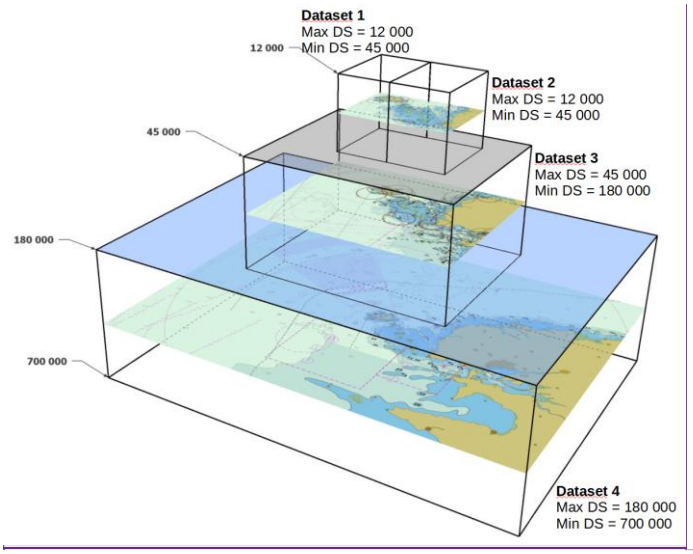

Figure 4-7 – Example of Datasets with single Data Coverage feature

- When a dataset has multiple **Data Coverage** features:
  a. The **minimum display scale**s must all be the same; and
  b. The **maximum display scale**s 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** features.

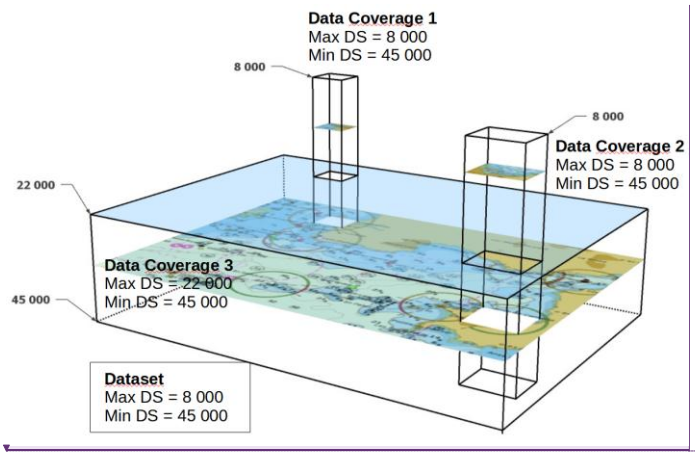

Figure 4-8 – Dataset with multiple Data Coverage features

4.5.4 Dataset size

Datasets must not exceed 10 MB.

Update datasets should not normally be larger than 50 kb and must not be larger than 200 kb.

Commented [JW56]: GB: Amend diagram 4.7 to show the largest scale at the bottom, in agreement Table 3-1 – ENC Minimum Display and Maximum Display Scales.
Dataset 1&2 MinDS 44,999
Dataset 3 MinDS 179,999
Dataset 4 MinDS 699,999
Otherwise, they overlap with corresponding MaxDS.

NIWC: Add optimum display scale.

IHO Sec: **To be discussed.**

Commented [JW57]: IHO Sec: 4th bullet removed as per GB comment.

Deleted: <#>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. ¶

Deleted: <#>,

Deleted: then t

Deleted: for all **Data Coverage** features within the dataset.

Deleted: must all be the same; and

Commented [JW58]: NIWC: Reflects the fact that the dataset must be shown in its entirety.

IHO Sec: This is predicated on the re-introduction of optimumDisplayScale. **To be discussed.**

Deleted: <#>The **optimum display scale**sfor multiple **Data Coverage** features within a dataset may be different.¶

Commented [JW60]: NIWC: Recommends removing this bullet.

IHO Sec: Regardless of the outcome of optimumDisplayScale discussions, think there still should be s statement as to what the maximum display scale for the dataset should be. **To be discussed.**

Commented [JW61]: Christian review 11/07/22: See https://github.com/iho-ohi/S-101-Documentation-and-FC/issues/17

•NIWC: Add optimum display scale (1:12k, 1:12k, and 1:22k)
• Remove dataset scale attributes
• All data coverage min/max scales should match (1:8k and 1:45k)

IHO Sec: **To be discussed.**

Deleted: <#>The **maximum display scale** is considered to be the equivalent of the compilation scale of the data.¶

Deleted: 7

Deleted: **Coverage rules**

Commented [JW62]: NIWC: These two requirements beg the question of why? It should be explained here. "In order to meet/minimize/limit/etc. …"

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 display scale**. The suggested viewing scale is defined by the **optimum display scale**. These scales must be set at one of the scales specified in clause 3 (spatial resolution).

When the mariner's selected viewing scale (MSVS) is smaller than the value indicated by **minimum display scale**, features within the **Data Coverage** feature are not displayed, except where the SENC does not contain a dataset covering the area at a smaller scale, in which case the dataset will be displayed as long as the MSVS is larger than twice the **minimum display scale**. When the MSVS is larger than twice the value indicated by **maximum display scale**, the overscale indication, in the form of an overscale factor and pattern covering the area that is overscale, must be shown. When at own ship's position a dataset with a larger **maximum display scale** than the MSVS is available, an indication is required and must be shown on the same screen as the chart display.

Table 4-2 – Display scale ranges - example

Data Coverage 1 + 2 (see Figure 4-8) **minimum display scale**: 45000; **maximum display scale**: 8000	
MSVS	***Display***
Smaller than 90000, for example 180000	no
90000 to 8000, for example 22000	yes
Larger than 4000, for example 3500	yes, with overscale indication

Data Coverage 3 (see Figure 4-8) **minimum display scale**: 45000; **maximum display scale**: 22000	
MSVS	***Display***
Smaller than 90000, for example 180000	no
90000 to 8000, for example 50000	yes
Larger than 11000, for example 8000	yes, with overscale indication

4.7 Dataset loading and display order

A new algorithm for dataset loading and unloading within a navigation system is prescribed in S-101 in order for the appropriate ENC to be viewed at the mariner's selected viewing scale. This will simplify the process for navigation systems, giving clear and concise rules on how and when data is loaded and unloaded. The concept of navigation purpose is restricted for use in presenting ENCs in a visual catalogue and must not be used for determining which dataset should be displayed.

Details of the dataset loading and data display algorithms are available in Annex D – *Dataset loading and data display algorithm*.

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 loading algorithm

The loading strategy consists of the following steps:

- Creation of the complete list (for example named LIST_MDS) of **Data Coverage** features contained in the SENC and ordered by values of **maximum display scale** (smallest scales first)

Commented [JW63]: IHO Sec: Refer to extensive comments from AU, DE, NIWC and GB in consolidated comments sheet. All these comments related to clause 4.6 need to be considered holistically as part of deliberations.

Commented [JW64]: GB: **The first paragraph** should be moved to Data Coverage Rules, because the Display Scale Range is fundamental to the Data Coverage Rules.
Move to 4.5.3 after bullet point in italics
- *The data boundary of the base dataset is defined by the extent of the **Data Coverage** features and must be contained within the bounding box.*
- 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 display scale**. These scales must be set at one of the scales specified in clause 3 (spatial resolutions).

IHO Sec: Perhaps clause 4.6 should be a sub clause of 4.5? Then perhaps there could be some re-shuffling to better order the specification. **To be discussed.**

Deleted: s

Deleted: system's

Commented [CM65]: See https://github.com/iho-ohi/S-101-Documentation-and-FC/issues/19

Deleted: at all smaller scales

Deleted: viewing scale

Commented [JW66]: NIWC: Doesn't match S-52 requirement – the pattern should only be shown on areas used to "fill-in" the display. The pattern should not be shown on areas the mariner intentionally overscales.

IHO Sec: Is this really the intent in S-52?

Deleted: is covered by

Deleted: mariner's selected viewing scale (

Deleted:)

Deleted: should

Commented [JW67]: Examples would be helpful to understand this part of the document better. Add proposed additional figure/table.

IHO Sec: Have added an edited version of the Table as a placeholder. **To be discussed**.

Commented [JW68]: NIWC recommended deletion.

Deleted: based on producer defined dataset display scales (minimum and maximum)

Commented [CM69]: In progress.

Commented [JW70]: NIWC: New paragraph added. Best scale dataset(s) should always be loaded for safety checking of the route plan and OS.

Commented [JW71]: NIWC: New paragraph added. S-52 ed 6.1.1 clause 3.3.1.2.

Commented [JW72]: NIWC: Remove or move 4.7.1 to Annex D. New alternate text for this clause proposed – refer to NIWC track-changed version.

IHO Sec: **To be discussed.**

and then by values of **minimum display scale** (largest scales first). This list is to be updated at each SENC change (new EN file).

- From LIST_MDS, creation of the complete list (for example named LIST_DC) of all **Data Coverage** features that intersect the system graphics window, with the same ordering rule.
- From LIST_DC, creation of the list (for example named LIST_DC_S) of **Data Coverage** features with a scale range compatible with the MSVS (**maximum display scale** > MSVS > **minimum display scale**).
- From LIST_DC_S, creation of the list of datasets that may participate in the display within the graphics window (for datasets with multiple **Data Coverage** features, the entire dataset must be selected even if only one **Data Coverage** feature intersects the graphics window).

4.7.2 Dataset display order

- The graphics window will be gradually filled by the features from **Data Coverage** features in LIST_DC_S.
- In case of overlapping **Data Coverage** features (they must have different **maximum display scale** values), 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 (**Data Coverage** features drawn "one on top of the other").
- In case of adjacent **Data Coverage** features with the same **maximum display scale**, the features will be drawn "side by side", that is according each feature object display priority.
- In case of a dataset with multiple **Data Coverage** features, as the features will not be split at the boundary between **Data Coverage** features, the data set will be drawn altogether.

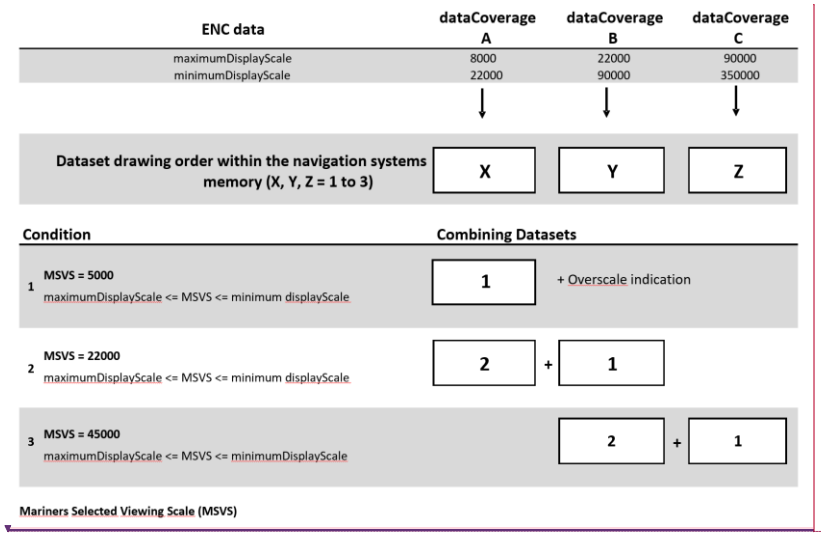

Figure 4-9 – Dataset loading and display rules

Commented [JW73]: DE: The following scenario is most obvious for areas where data sets with identical max ds may overlap (adjoining national data limits), but it also applies to all scenarios of data set overlap. The described method of creating a display order will prioritize data with a smaller min ds in the display order (covering data with larger min ds, because it is drawn later). Is that intended? Should not data with potentially more information/details (larger min ds) be displayed when possible (drawn later and therefore covering data with smaller min ds)?

Commented [JW74]: DE: How does this list (LIST_DC_S) account for MSVS that are outside of the originally intended display scale of a data coverage feature? In some cases those will need to be displayed for lack of other (more appropriate) data.
Is there a second list, that contains all entries from LIST_DC minus the ones that formed LIST_DC_S, that match the conditions (for scale numbers) "MSVS < max ds <= 2*MSVS" and "MSVS < min ds <= 2*MSVS" for filling gaps in the display where no MSVS appropriate data sets are available?

Commented [JW75]: 7Cs: maximum display scale > MSVS < minimum display scale
Should be: maximum display scale > MSVS > minimum display scale

DE: If referring to the scale itself then it should be: max ds > MSVS > min ds. If it refers to the scale number, then it should be: max ds < MSVS < min ds. To avoid confusion maybe the wording could be amended to clarify which numbers are referred to.
Either "max ds > MSVS > min ds" or "max ds < MSVS < min ds" +
Clarification which numbers are referred to (scale or scale number)

Commented [TS76]: DE: If MSVS is considered for dataset display order the text should be changed as proposed.
LIST_DC -> LIST_DC_S

IHO Sec: Tend to agree, however to be confirmed.

Commented [TS77]: IHO Sec: Clause 4.5.3 states that where a dataset ha multiple DataCoverage features the minimumDisplayScale in each DataCoverage must be the same (assuming the Figure is associated with the bullet immediately preceding?).
Amend minimumDisplayScale values for each data coverage at the top of the Figure to the same value (350000).

I find this Figure to be confusing. There needs to be a better relationship established between the Figures and the associated text in the clause (references to Figure numbers in the text); then the Figures rationalised. **To be discussed.**

7Cs: Condition: maximumDisplayScale <= MSVS <= minimumDisplayScale.
In clause 4.6: Twice maxDS, twice min.DS.

IHO Sec: Agree. **To be discussed.**

7Cs: Minimum displayScale -> minimumDisplayScale

IHO Sec: Agree: **To be applied.**

Deleted: This clause defines the dataset loading and unloading algorithm for use within marine navigation systems. ¶
In order for systems to properly load and unload data as the mariner is zooming in and out using the mariner's selected viewing scale (MSVS) the following algorithm must be used.

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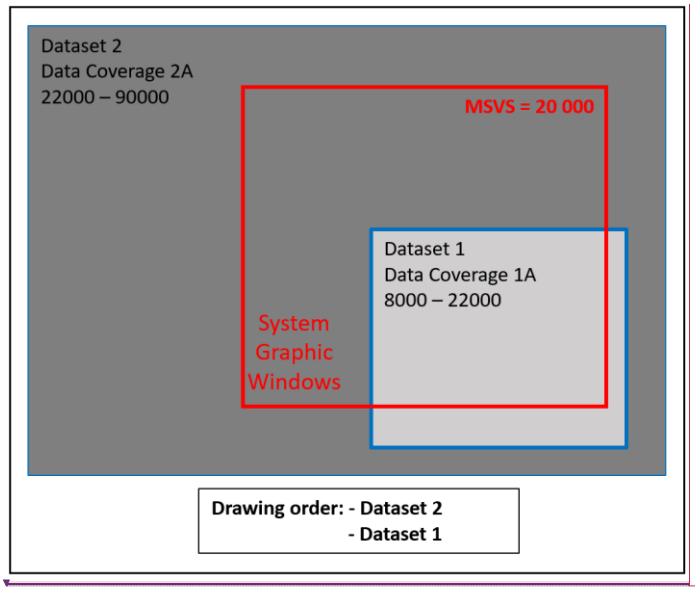

Figure 4-10 – Scenario 1: Simple Data Coverage display

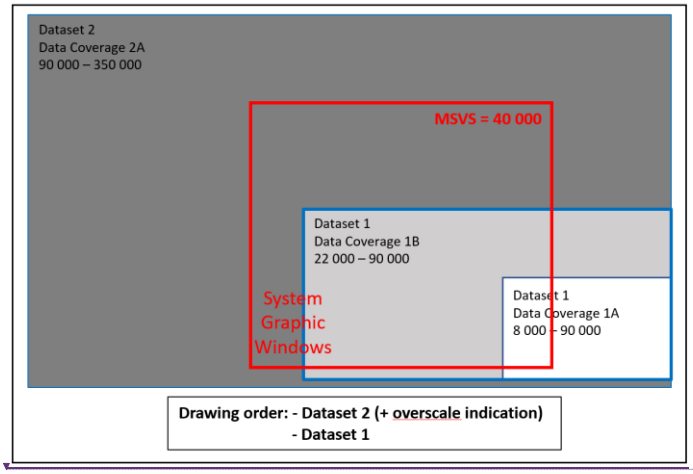

Figure 4-11 – Scenario 2: Display of overlapping datasets and multiple Data Coverages

Commented [TS78]: 7Cs: - Why X, Y, Z and 1, 2, 3?
- Use always same size for numbers.

IHO Sec: Consider all Figures in this clause need review so as to establish a better relationship. **To be discussed.**

Deleted: <#>1. Create selection List:¶
a. All **Data Coverage** areas within the graphics window within scale range (covered by the MSVS) 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 MSVS is larger than the **maximum display scale** of an area within the window, turn on overscale indication.¶
3. . If the mariner selects an individual dataset to load it must be displayed at its **maximum display scale**; that is, MSVS 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 **maximu**...

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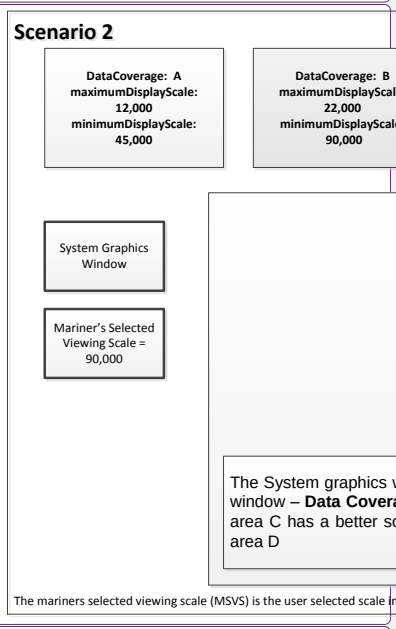

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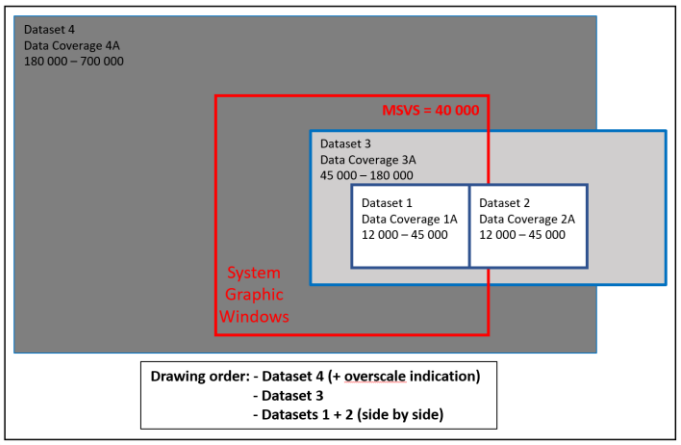


Figure 4-12 – Scenario 3: Display of overlapping and adjacent Data Coverages

4.8 Geometry

4.8.1 S-100 level 3a geometry

The underlying geometry of an ENC 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:

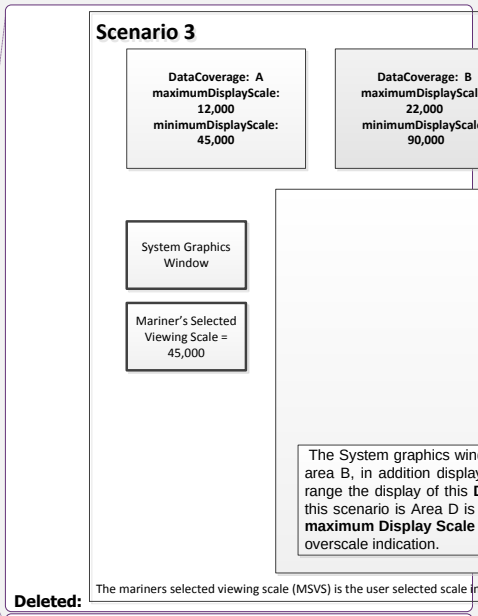
- Each curve must reference a start and end point (they may be the same).
- Curves must not self intersect. See Figure 4-13.
- Areas are represented by a closed loop of curves beginning and ending at a common point.
- In the case of areas with holes, all internal boundaries must be completely contained 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 4-14.
- 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 4-15.

S-101 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 segment contains the geographic coordinates as control points and defines an interpolation method between them. The distance between two consecutive control points must not be less than 0.3 mm at the maximum display scale of the data.

The following exception applies to S-101:

- The use of coordinates is restricted to two dimensions, except in the case of features encoded using GM_Point (point) and GM_Multipoint (pointSet) which may have three dimensional coordinates.



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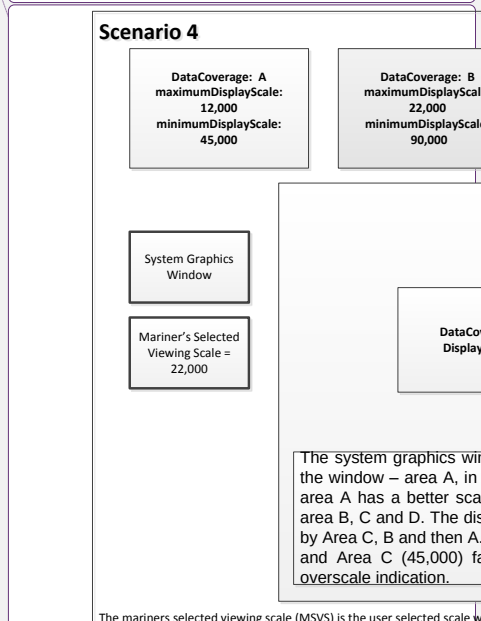

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¶

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

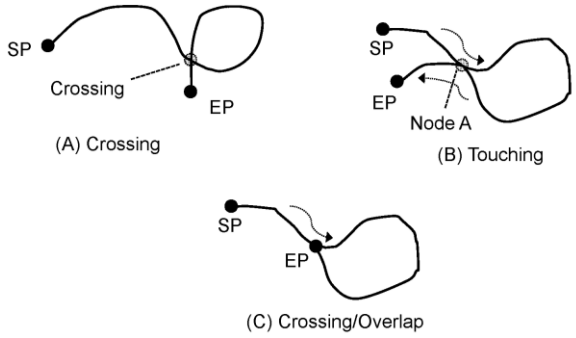

Figure 4-13 – Self intersect example

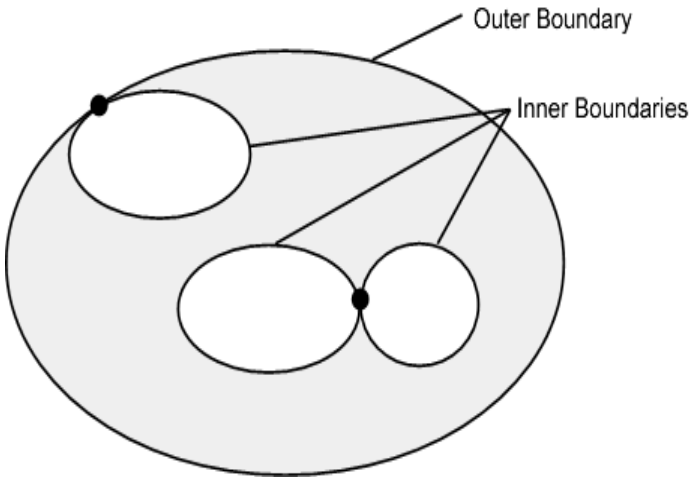

Figure 4-14 – Area Holes

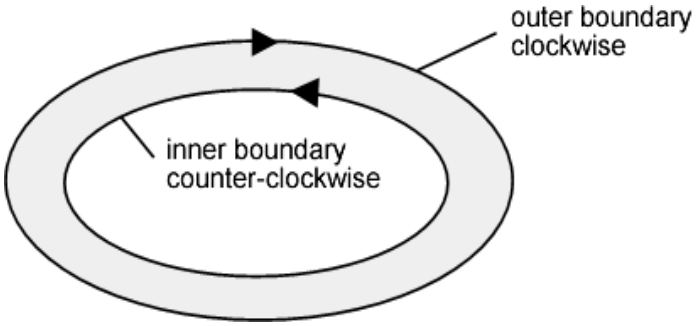

Figure 4-15 – Boundary direction

4.8.2 Masking

In certain circumstances, the symbolisation 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] subfield must be set to either {1} or {2} (see Annex B – clause B-5.1.33).

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

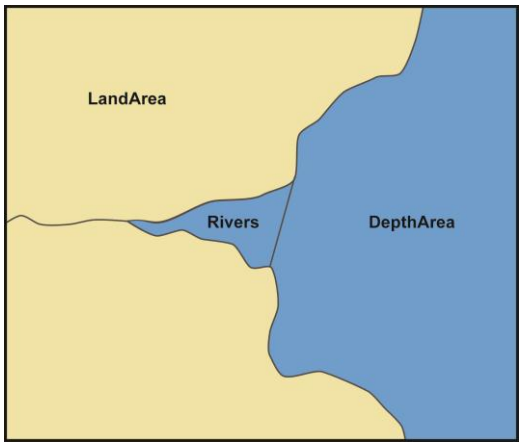


Figure 4-16 – Example without masking

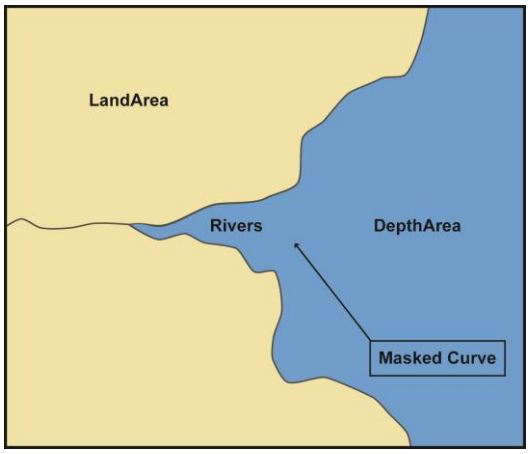


Figure 4-17 – Example with masking

5 Coordinate Reference Systems (CRS)

5.1 Introduction

An ENC 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.

5.2 Horizontal Coordinate Reference System

For ENC 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:	http://www.iogp.org

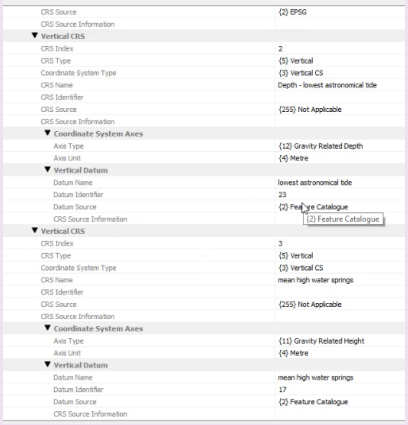
5.3 Vertical CRS for Soundings

For ENC the vertical CRS must be in metres. Depths are represented by positive values, while negative values indicate 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 for the Coordinate Reference System record fields can be found at Annex B, clauses B-5.1.9 to B-5.1.12; and is demonstrated with the following examples. The example at Table 5-1 specifies a compound CRS. The first component is a 2D Geographic CRS (WGS84). The second component is

Commented [JW79]: Lloyds Register: In S-57 there were both a sounding datum and a vertical datum. When reading clause 5 it only refers to Vertical CRS for Soundings. Why is there no reference to Vertical CRS for Heights? Why does not S-101 dataset imply the encoding to the Vertical CRS for heights? It would be logical to have them both in one place. We know we have this value in meta data .xml file, however, it will be logical to have description of all CRS in one place. Below you can see how we imagine the encoding:



Add a clause 5.4 Vertical Datum for heights.
Describe the encoding of CRSH, CSAX and VDAT fields with corresponding sub-fields:
CRSH-CRST =5: Vertical
CRSH-CSTY =3: Vertical
CSAX-AXTY =11: Gravity Related Height
VDAT-DTNM and DTID values of the corresponding default datum ...

Commented [JW80]: 7Cs.

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Commented [JW81]: NIWC: This should probably be a sub-section under a more general section applying to all vertical CRS's (soundings and heights).

IHO Sec: To be discussed in relation to the comment from Lloyds Register.

Commented [JW82]: NIWC: This requirement should apply to all vertical CRS, but is in a section specific to soundings.

IHO Sec: **Agree.** This tends to support the above comment that there should be a holistic clause addressing all CRS (sounding and vertical). **To be discussed.**

Commented [JW83]: NIWC: Technically, this depends on the value of AXTY in the CSAX component. There should be a requirement that AXTY corresponding to Vertical CRS's for soundings must be 12 (gravity related depth – positive down), while AXTY corresponding to Vertical CRS's not for soundings must be 11 (gravity related height – positive up). ...

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Commented [JW84]: DE: Add reference to where the general encoding of CRS is presented. -> B-5.1.9 - B-5.1.12.

IHO Sec: **Agree.** Draft changes included for discussion.

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a Vertical CRS for depth using the Vertical Datum: Lowest Astronomical Tide.

Table 5-1 – Compound CRS (WGS84 and 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 - lowest astronomical tide	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	lowest astronomical tide	Datum Name
	DTID	23	Datum Identifier (23 = Lowest Astronomical Tide)
	DTSR	2	Datum Source (2 = Feature Catalogue)
	SCRI		Datum Source Information (omitted)

The example at Table 5-2 is similar to the 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

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Commented [JW85]: 7Cs

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Commented [JW86]: NIWC: This is ok for soundings, but heights should use 11.

IHO Sec: **Agree.** To be discussed with previous NIWC comment.

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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 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 sea level	Datum Name
	DTID	3	Datum Identifier (3 = Mean Sea Level)
	DTSR	2	Datum Source (2 = Feature Catalogue)
	SCRI		Datum Source Information (omitted)

Commented [JW87]: NIWC: This is ok for soundings, but heights should use 11.

IHO Sec: **Agree.** To be discussed with previous NIWC comment.

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 scope for 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-101 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; and
  - Specific tests for compliance against the S-101 data model.

For S-101 data quality is divided into two parts – data compliance, usability and integrity against all requirements of S-101; and bathymetric data quality.

6.1.1 Data compliance and usability

All S-101 datasets must be validated against the above data quality elements using conformance checks that are located in Annex C – *ENC Validation Checks*. As a minimum requirement, all datasets must conform to all checks that are categorized as "Critical" in Annex C.

S-101 datasets must conform to all mandatory elements of Annex A – *Data Classification and 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-101 Product Specification, including context-specific evaluation of individual encoding instances for requirement of conformance to checks classified as "Error" and "Warning" in Annex C – *ENC Validation Checks*.

For dataset integrity requirements, see clause 11.6.

7 Data Capture and Classification

The S-101 ENC Data Classification and Encoding Guide (DCEG) describes how data describing the real world should be captured using the types defined in the S-101 Feature Catalogue. This Guide is located at Annex A.

8 Maintenance

8.1 Introduction

This clause describes the requirement 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 based marine navigation system.

8.2 Maintenance and update frequency

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

8.3 Data source

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

8.4 Production process

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Data Producers should follow their established production processes for maintaining and updating datasets. Data must be maintained against S-101 Annex A – *Data Classification and Encoding Guide*, checked against S-101 Annex C – *ENC Validation Checks*, and encapsulated in ISO/IEC 8211.

Only maintained datasets that conform to the mandatory requirements outlined in S-101 will be considered to be an ENC satisfying the SOLAS chart carriage requirements for use in an ECDIS.

8.5 Feature and Portrayal Catalogue management

For each new version of the S-101 Product Specification a new Feature and Portrayal Catalogue will be released. The end user system must be able to manage datasets and their corresponding Catalogues that are created using different versions of the S-101 Product Specification.

Commented [JW88]: DE: Has a decision been made of how many different versions will be supported at once?

IHO Sec: Not sure about this one. Is there something about this in S-98?

NIWC: Does this information add value? Recommend delete. If retained, it could use more detail – new versions of the FC and/or PC may be released independent of changes to the PS – for example, in the case of corrections.

IHO Sec: **To be discussed.**

9 Portrayal

9.1 Introduction

S-101 portrayal is intended to contribute to the safe operation of an S-100 based marine navigation system by:

- Ensuring base and supplementary levels of display for ENC 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;
- Establishing an accepted pattern for presentation that becomes familiar to mariners and so can be recognized instantly without confusion; and
- Utilizing the S-100 portrayal model to ensure interoperability.

S-101 portrayal is covered by the portrayal model as defined in S-100. This model reflects how the Portrayal Catalogue is defined for use in marine navigation systems. The Portrayal Catalogue defines symbology and the portrayal rules for each feature/attribute combination contained in the Feature Catalogue.

S-101 uses the portrayal process defined in S-100 Part 9A.

9.2 Portrayal Catalogue

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

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Table 9-1 – S-101 Portrayal Catalogue

No.	ISO class or attribute	Type	Value
--	CI_Citation	Class	--
1	title	CharacterString	S-101 Portrayal Catalogue
2	date	CI_Date (class)	--
2.1	date	DateTime	2022-xx-xxT00:00:00
2.2	dateType	CI_DateTypeCode (ISO codelist)	publication
3	edition	CharacterString	1.1.0
4	editionDate	DateTime	2022-xx-xxT00:00:00
5	citedResponsibleParty	CI_Responsibility (class)	--
5.1	role	CI_RoleCode (ISO codelist)	publisher
5.2	party	CI_Organisation (class)	--
5.2.1	name	CharacterString	International Hydrographic Organization

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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.")
7	onlineResource	CI_OnlineResource (class)	--
7.1	linkage	CharacterString (URL)	https://registry.iho.int/
7.2	name	CharacterString	S-101 Portrayal Catalogue
7.3	description	CharacterString	XML Portrayal Catalogue accompanied by related files for symbols, colour profiles, rules, etc

The Portrayal Catalogue contains the mechanisms for the system to portray information found in S-101 ENCs. The S-101 Portrayal Catalogue contains the following types of mechanisms and structures:

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

The Portrayal Catalogue model is defined in S-100 Part 9, clause 9-13.

The S-101 Portrayal Catalogue is 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.

10 Data Product Format (Encoding)

10.1 Introduction

This clause specifies the encoding for S-101 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 (S-100 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 B-5.1.2).

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 B-5.1.2). This Product Specification limits the resolution to one decimal place and therefore the [CMFZ] must be set to {10}.

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

Note: This does not apply to depth encoded as attributes.

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).

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Commented [JW89]: NIWC: Delete – this is out of date wrt S-100, and we just said it's defined in S-100.

IHO Sec: **Agree.** Have amended the clause to include more specific references in S-100 Part 9 – for consideration.

Deleted: 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)

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Commented [JW90]: Holger review 24/06/22

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Commented [JW91]: Holger review 24/06/22

Commented [TS92]: Refer Paper S-101PT8-22 and Action S-101PT8/33.

Lloyds Register: The values of the DSSI-CMFZ sub-field in prod Spec and in DCEG the clauses 11.3.1 and 11.8.1 must match. Now Spec indicates value {10} but the latest version DCEG uses value 100.
Set identical value for both documents.

IHO Sec: Refer to above referenced Paper and Action. DCEG value amended to {10}.

Deleted: 0

10.1.5 Unknown attribute values

In a Base 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-101 ENC. Data which conforms to this Product Specification must be delivered by means of an Exchange Set.

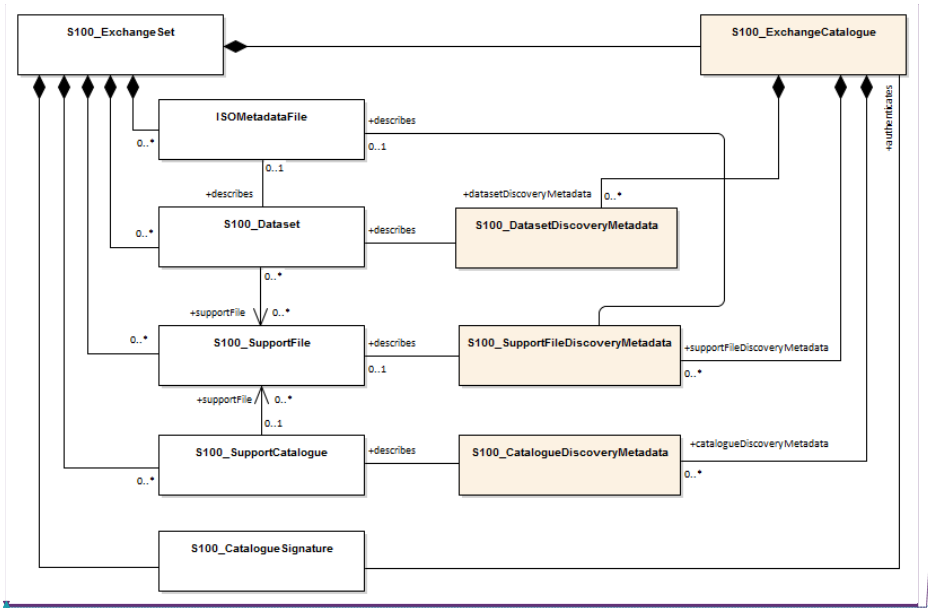

Figure 11-1 – Exchange Set Structure

11.2 Exchange Set

S-101 datasets are grouped into Exchange Sets. Each Exchange Set consists of one or more ENC datasets with an associated XML metadata file and a single Exchange Catalogue XML file containing metadata. It may also include one or more support files. The S-101 Exchange Set structure is the same as that described in S-100 and depicted in Figure 11-1 above.

Units of Delivery: Exchange Set

Transfer Size: Unlimited

Medium Name: Digital data delivery

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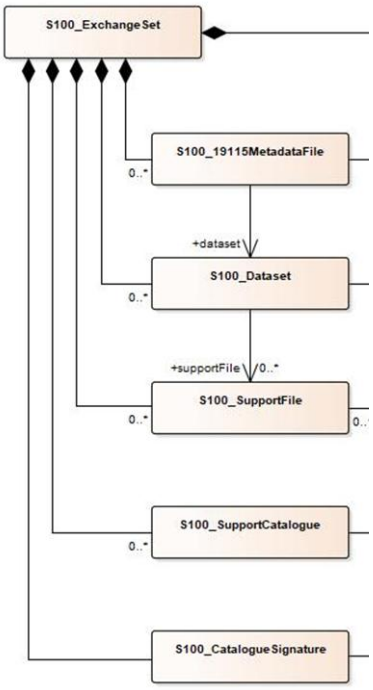
Commented [JW93]: Raphael 29/06/22: Add a sentence about what it means **in the context of S-101**.
Refer to it and/or at least some of its components in clause 11.2, again in the context of S-101.

JW : Need help with the sentences and references suggested by Raphael above.



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Commented [TS94]: This clause needs a complete review in regard to how S-100 Exchange Sets in general are to be structured. For example Exchange Sets containing data sets from more than one S-100 based PS?

Commented [JW95]: PRIMAR: Following up from the comment above related to the associated XML Metadata file: Should this file have a defined naming convention?
If yes – refer to S-100 5.0.0 Part 10c-12 for HDF5 encoding where the naming convention for associated Metadata files are:
MD_<data file base name>.XML

IHO Sec: **To be discussed.**

Commented [JW96]: PRIMAR: Does this mean that an associated XML metadata file must be created for all dataset files?
If yes – It should be added to 11.2.1 as a mandatory element for clarification.

Other Delivery Information:

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 attribute **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-101 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

- ENC datasets – ISO/IEC 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 mapping from the name included within the dataset and the physical location on the media is defined within the Exchange Catalogue.
- S-101 Feature Catalogue – If it is necessary to deliver the latest Feature Catalogue to the end user it may be done using the S-101 Exchange Set mechanism for datasets.
- S-101 Portrayal Catalogue – If it is necessary to deliver the latest Portrayal Catalogue to the end user it may be done using the S-101 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 ENC 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. They must only cover the same geographical area as the base cell file to which they apply. The encoding structure for an Update is located in Annex B – 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 loading of the Base cell and all applicable updates individually for new users of the dataset, therefore does not contain any new 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 the system. The encoding structure for a Cancellation file is located in Annex B – clause B-7.

Commented [JW97]: NIWC: Delete – delivery of files on physical media is not required.

IHO Sec: Does this specifically infer physical media? Am not sure. **To be discussed.**

Commented [TR98]: Propose simplify by referring to S-100 Part 17 directly and not repeating these rules here.

Commented [JW99]: Lloyds Register: The information about name and geographic area consistency base dataset and its updates are missing. The S-57 prod Spec contains the following sentence: *"Update cell files have the same name as the original base cell file, with an extension number greater than or equal to 001. They cover the same geographical area as the base cell file to which they apply".* Will S-101 exchange set support update dataset with different names? Can they extend Data Coverage area of Base cell?
Add the following sentences to the end of clause:
Update dataset files have the same name as the Base dataset file, with an extension number greater than or equal to 001. They are covered by the geographical area of the Base dataset to which they apply.

IHO Sec: Original comment was to insert this new guidance at clause 11.3.2. Have chosen to add here to be consistent with guidance for New Edition above. **To be discussed.**

Deleted:

11.3.2 Dataset file naming

101CCCCØØØØØØØØØØ.EEE

The file name forms a unique S-101 identifier where:

- 101 – the first 3 characters identify the dataset as an S-101 dataset (mandatory).
- CCCC – the fourth to seventh characters identify the Producer Code of the issuing agency (mandatory for S-101). 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 to the maximum 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 (upper case characters only), 0 to 9 and the special character _ (underscore). It is not required to use all the available characters, however at least one character must be used.
- .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.

11.3.3 New Editions, re-issues, updates and cancellations

This section defines the sequencing of S-101 datasets for New Editions, updates and re-issues. In order to ensure that feature type updates are incorporated into an end user system 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 subsequent 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 method 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

Dataset support files offer supplementary information that can be included in an ENC Exchange Set.

- Text files must contain only general 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 must be in TIFF (6.0 specification) **(TIFF)**.

Table 11-1 – Support file extensions

File Types	Extensions	Comment
Text	TXT	

Commented [JW100]: AU: The use of 4 characters (CCCC) to express the country code of a producer country, when it is currently defined in S-62 as a two-character combination, does not make a lot of sense.
It is true that ISO has a three-letter code to uniquely identify countries (and many members use it to number their paper products) but the IHO did never recommend their use in the charting specs.
Consider interpreting S-100 guidance on the use of a country code (characters YYYY in S-100) as any number of characters as registered in the IHO Registry.
Therefore, as the IHO Registry has 2-letter country/private organisations codes, S-101 datasets would have 2 characters allocated for this purpose, not four (CC instead of CCCC).
For example:
101AU_P_SYD01 instead of
101AU00_P_SYD01
Another (controversial we think) option is to establish, from scratch, a new dedicated list of country codes for S-100 products and allow countries and organisations to register a code using 2-4 characters. Once created, any S-100 related file name, etc. that requires a country code populated, must use one from that list and there should not be any additional requirement to encode ‘extra’ zeros to get to 4 characters.

IHO Sec: It has been determined that the list of 2-character codes that can be assigned will not satisfy future requirements. **Suggest retain as is.**

Commented [TS101]: Needs to be discussed (S-100WG) as what is described here may not necessarily be the way that this should work. May need to be a look-up table generated from the GI Registry?

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Commented [JW102]: PRIMAR: Dataset file naming is expressed with numbers and upper case letters: 101CCCCØØØØØØØØØØ.EEE
Does this mean that only upper case letters are allowed in the dataset filename?
If yes – add following sentence to 3rd bullet: Characters must be upper case.
If no: - add following sentence to 3rd bullet: Characters may be lower or upper case.

IHO Sec: Have chosen to go with upper case only, and have simply added some bracketed text to resolve this comment. **To be confirmed.**

Commented [JW103]: Lloyds Register: If the use of characters eight through seventeen is optional, does this mean that these characters may not exist at all? For example: Is the dataset name 101GB00.000 valid? ...

Commented [JW104]: PRIMAR: 11.3.3 describes a number of parameters encoded in the data and how they are used. The parameter “Update comment” indicates the possibility to encode a description of the change introduced by the update ...

Commented [JW105]: DE: message = method? ...

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Commented [JW106]: AU: Unnecessary use of brackets. Remove brackets from last sentence of the first bullet point: (Extensible mark-up language (XML) supports UTF-8 character encoding.) ...

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	HTM	HTML files must only include inline or embedded Cascading Style Sheet (CSS) information and must not contain embedded Javascript or other dynamic content, for example DHTML, Flash etc.
	XML	XML documents must only be included in accordance with guidance provided within the Data Classification and Encoding Guide (S-101 Annex A). This may include a Schema for the validation of XML documents.
Picture	TIF	Baseline TIFF 6.0.

11.4.1 Support file Naming

All 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 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 support files are named according to the specifications given below:

101CCCCØØØØØØØØØØ.EEE

The main part forms an identifier where:

- 101 – the first 3 characters identify the support file as applicable to an S-101 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 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 support file name. The following characters are allowed in the support file name: A to Z (upper case characters only), 0 to 9 and the special character _ (underscore). It is not required to use all the available characters, however at least one character must be used.
- .EEE – support file extension. (TXT, HTM, XML or TIF).

11.4.2 Support file management

When a support file is created or a subsequent version is issued it must carry its own issue date and be supported with a digital signature which authenticates it against the Producer’s public key included in the Exchange Set metadata.

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

Each support file required must be included only once in the Exchange Set.

Support files must be stored in a separate folder within the Exchange Set, refer to Figure 12-3 – S-101 Exchange Set.

Re-use of a support file name after a deletion period is possible only if the support file edition number is higher than the previous edition number before 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 a 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 New Edition of a support file contains changes not applicable to all previous associated features, a completely new file must be created instead. This is to maintain the support file information in the associated features not effected by the last changes. The associations to the old file must then be

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Commented [JW107]: AU: The use of 4 characters (CCCC) to express the country code of a producer country, when it is currently defined in S-62 as a two-character combination, does not make a lot of sense.
It is true that ISO has a three-letter code to uniquely identify countries (and many members use it to number their paper products) but the IHO did never recommend their use in the charting specs.
Consider interpreting S-100 guidance on the use of a country code (characters YYYY in S-100) as any number of characters as registered in the IHO Registry.
Therefore, as the IHO Registry has 2-letter country/private organisations codes, S-101 datasets would have 2 characters allocated for this purpose, not four (CC instead of CCCC).
For example:
101AU_P_SYD01 instead of
101AU00_P_SYD01
Another (controversial we think) option is to establish, from scratch, a new dedicated list of country codes for S-100 products and allow countries and organisations to register a code using 2-4 characters. Once created, any S-100 related file name, etc. that requires a country code populated, must use one from that list and there should not be any additional requirement to encode ‘extra’ zeros to get to 4 characters.

IHO Sec: It has been determined that the list of 2-character codes that can be assigned will not satisfy future requirements. **Suggest retain as is.**

Commented [TS108]: Needs to be discussed (S-100WG) as what is described here may not necessarily be the way this this should work. May need to be a look-up table generated from the GI Registry?

Commented [JW109]: PRIMAR: Dataset file naming is expressed with numbers and upper case letters: 101CCCCØØØØØØØØØØ.EEE
Does this mean that only upper case letters are allowed in the dataset filename?
If yes – add following sentence to 3rd bullet: Characters must be upper case.
If no: - add following sentence to 3rd bullet: Characters may be lower or upper case.

IHO Sec: Have chosen to go with upper case only, and have simply added some bracketed text to resolve this comment. **To be confirmed.**

Commented [JW110]: Lloyds Register: The mechanism of replacement of a support file is not clear. What should be included in updating Exchange set if a support file is just replaced?
We should include new support file and Exchange Catalogue with discovery metadata for the support file.
However, no dataset update has been created since features that refer to the support file were not changed. It contains a file named according to DCEG but not MRN. We just replaced the support file while its name was not changed. Consequently, there is no update dataset in the Exchange set. This contradicts the 11.2.1 clause.
Should we reflect changes of support file substance by updating features in dataset? If so, we probably, need to create fake update records of attributes changes that refer to the support file. Or we need to add Update information meta feature linked with features that refer to support file.
Add a clarification about how to create Update dataset to reflect replacement of the support file.

IHO Sec: This needs a fully worked scenario that describes the requirement. **To be discussed.**

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removed and new associations created for the new support file. Features where changes were not applicable will continue to use the old support file.

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

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

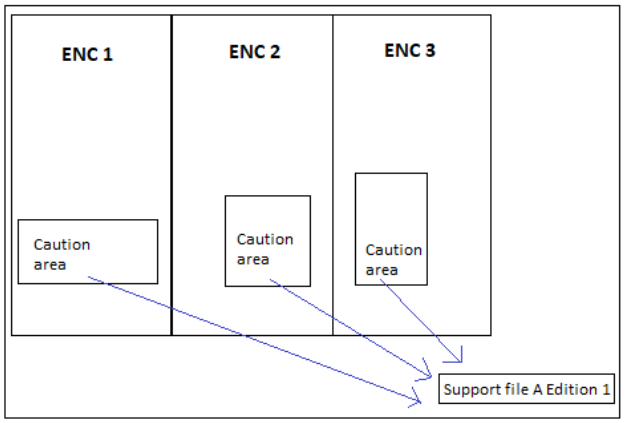

Figure 11-2 – Reference to new support file

Changes occur making it necessary to issue a New Edition of support file A. Edition 1 is no longer valid, and all 3 caution areas refer to the New Edition of support file A (Edition 1 of the support file is deleted from the system if referenced by no features):

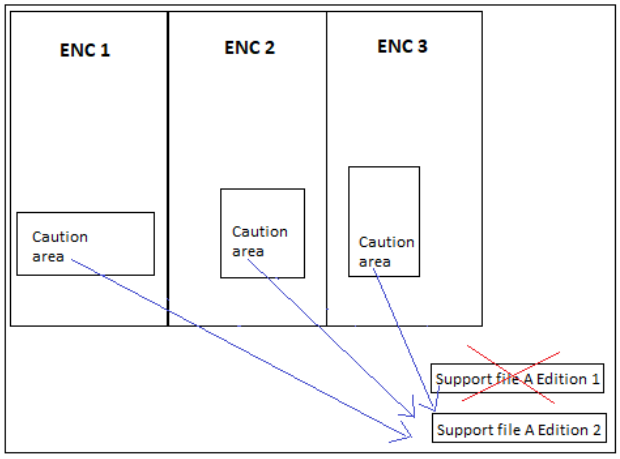

Figure 11-3 – Reference to New Edition of a support file

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Changes occur that are only applicable to the Caution areas in ENC 1 and ENC 2. Consequently, these ENCs can no longer refer to support file A Edition 2:

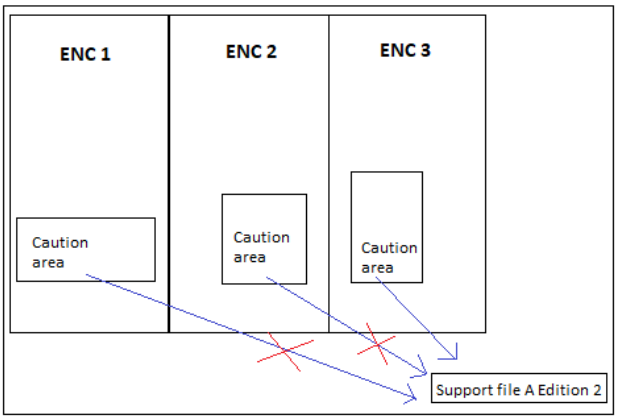

Figure 11-4 – Changes to support file affecting limited referenced features

A new support file B must be created for ENC 1 and ENC 2 to use as reference:

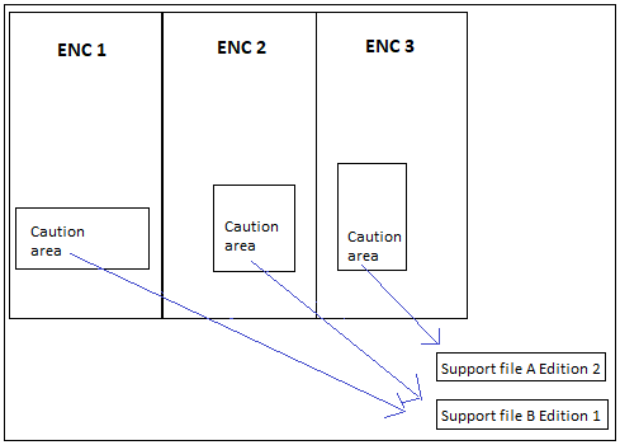

Figure 11-5 – New support file affecting limited referenced features

11.5 S-101 Exchange Catalogue

The S-101 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-101 Exchange Catalogue are described in Clause 12.

11.6 Data integrity and encryption

Out of scope for S-101 Edition 1.0.0. Under development by S-100WG and will be included for Edition 2.0.0.

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Commented [TR111]: Propose add reference to S-100 Part 15

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.

Figures 12-1 to 12-3 below outline the overall concept of an S-101 Exchange Set for the interchange of geospatial data and its relevant metadata. Figure 12-1 depicts the realization of the ISO 19115-1 and 19115-3 classes which form the foundation of the Exchange Set. The overall structure of S-101 metadata for Exchange Sets is the same as S-100 metadata. Figure 12-2 depicts the structure of the Exchange Set Catalogue and the structure of the Exchange Set is depicted in Figure 11-1 and described in clause 11.2. More detailed information about the various classes is shown in Figure 12-3 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 important information about the datasets and accompanying support files to be examined without the need to process the data, for example decrypt, decompress, load etc. Other Catalogues can be included in the Exchange Set in support of the datasets such as Feature and Portrayal. The attribute “purpose” of the support file metadata provides a mechanism to update support files more easily.

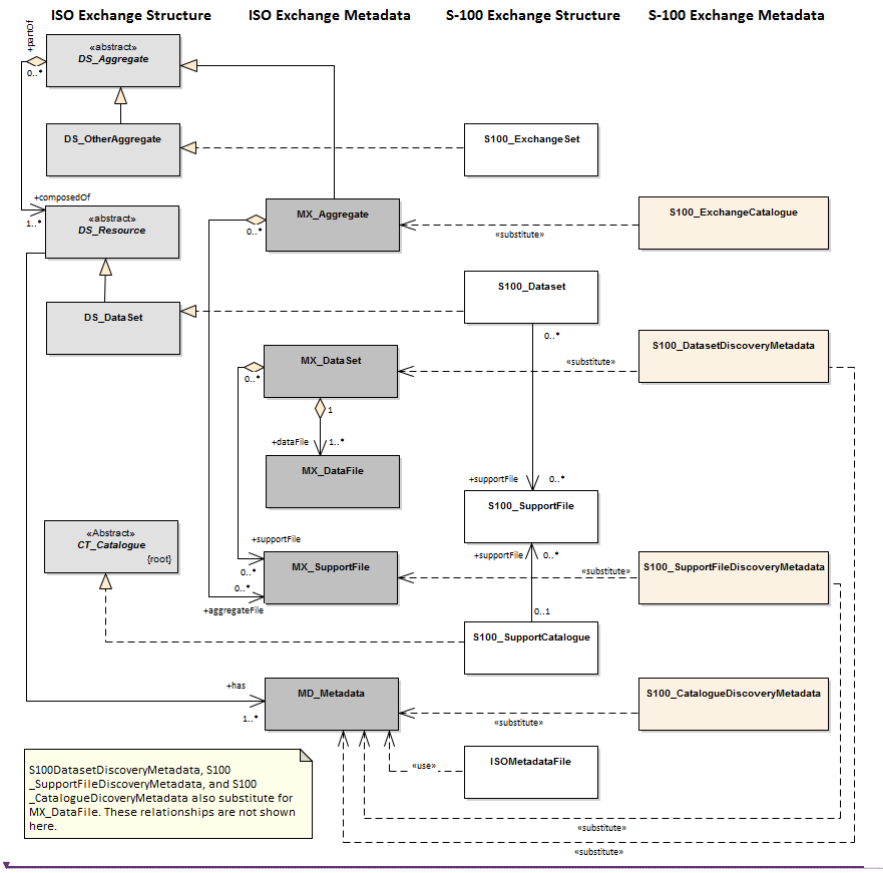

Figure 12-1 – Realization of the Exchange Set classes

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Commented [JW112]: Change applied iaw with comment in Raphael review 29/06/22. See comment below related to removal of former Figure 25.

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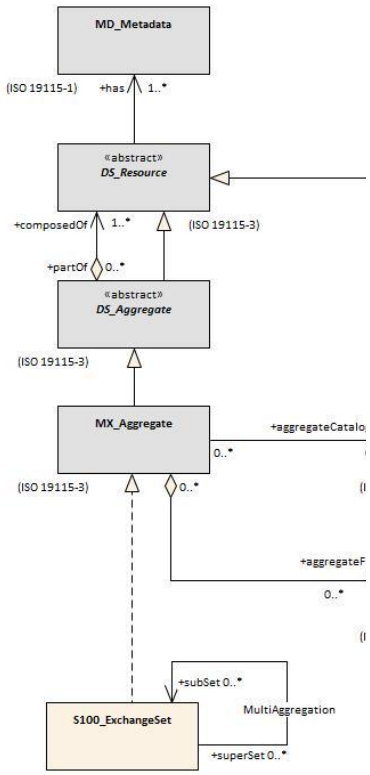

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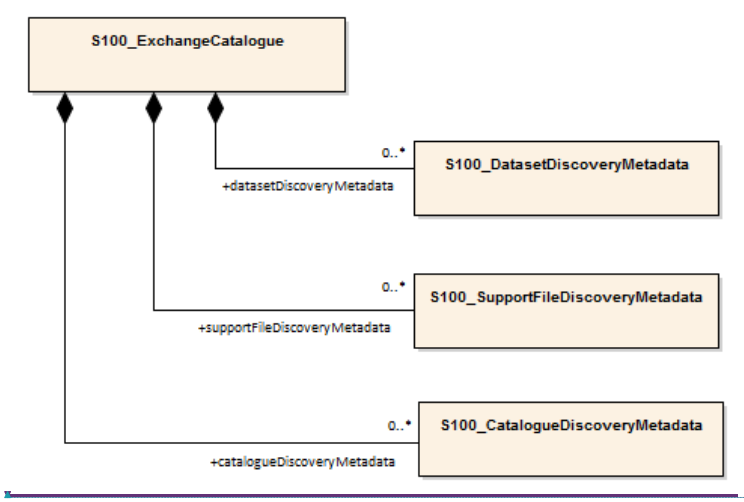
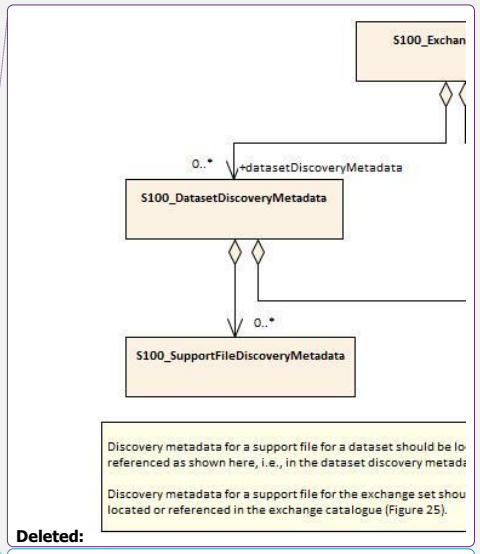


Figure 12-2 – S-101 Exchange Set Catalogue



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Commented [JW113]: Former Figure 25 removed: Raphael review 29/06/22: Delete. The structure of exchange sets is described in clause 11.2

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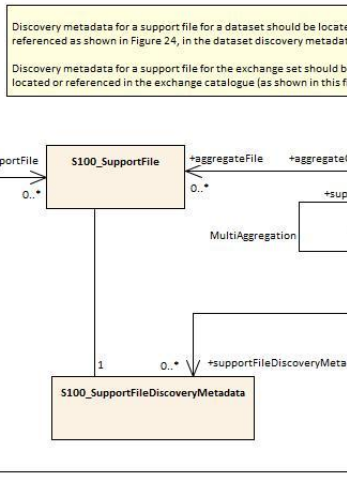

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Figure 25 12-3 – S-101 Exchange Set¶

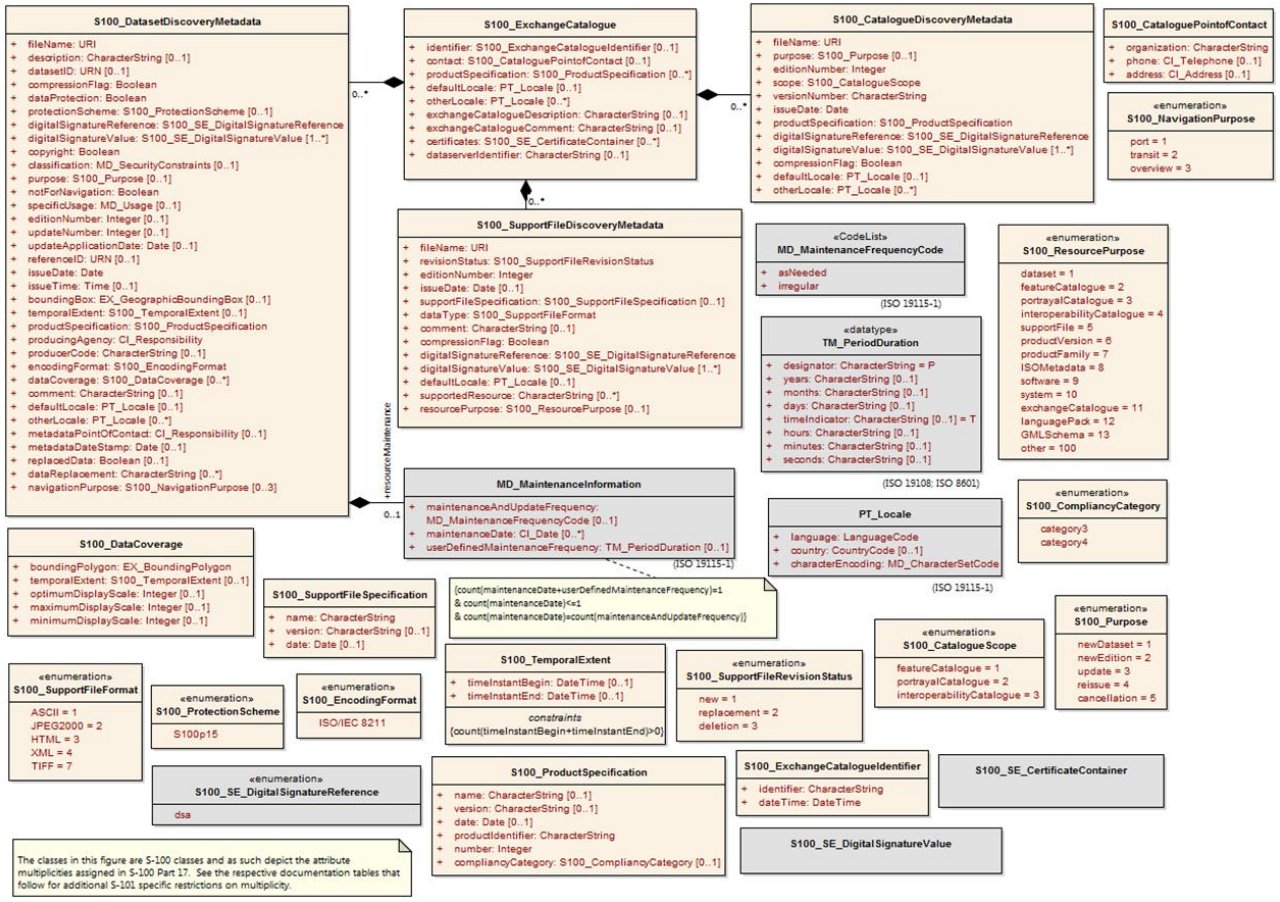

Figure 12-3 – S-101 Exchange Set - class details

Commented [JW114]: Raphael review 29/06/22: Replace with the accompanying figure. That figure should be compared to the tables below to ensure that it includes all and only the classes and attributes actually used in S-101. If an attribute is added or removed from the tables, the figure will also have to be updated.
The attribute multiplicities in the figure are the original S-100 multiplicities; they cannot be changed to the S-101-constrained S-100 multiplicities without unnecessary extra effort that wouldn't actually represent reality because S-101 will actually use the generic S-100 exchange catalogue schema.

JW: Need help with this due to limited time.

NIWC: Recommend delete and reference S-100 5.0 Figure 17-7. Note S-101 specifics in the UML tables below.

IHO Sec: Even though it will require additional maintenance and alignment, consider that it is better to have all this information in the PS as it is important and will save readers from having to go and interpret another Figure in another document and then work out the different multiplicities from the Tables below. **To be discussed.**

DE: Replace Fig. 12-3 proposed alternative figure/table (follows consolidated comments Table).

IHO Sec: **To be discussed.**

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The following clauses define the mandatory and optional metadata needed for S-101. 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-101 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 Parts 4a and 17, and a comment noting the restricted multiplicity has been included in the Remarks column. These attributes are named in the note in Figure 12-3. Further, enumerations in Figure 12-3 and the following clauses show only the values allowed in S-101 Exchange Catalogues.

12.1.1 S100_ExchangeCatalogue

The Exchange Catalogue inherits the dataset discovery metadata and support file discovery metadata from S-100 with additional S-101-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-101
contact	Details about the issuer of this Exchange Catalogue	1	S100_CataloguePointOfContact	0..1 multiplicity in S-100 restricted to 1 in S-101
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-101 0..* multiplicity in S-100 restricted to 1..* in S-101
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-101
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_CertificateContainer	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	

Commented [TS115]: TBC.
Commented [JW116]: NIWC: It's hard to see how these ...
Commented [JW117]: Raphael review 29/06/22: Delete t ...
Commented [JW118R117]: Have restructured iaw S-100 ...
Commented [JW119]: NIWC: Recommend remove. ...
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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	-	-	-
Attribute	identifier	Uniquely identifies this Exchange Catalogue	1	CharacterString	<S100XC:identifier>US_101_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	

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Commented [JW122]: Raphael review 29/06/22: The S-100 WG decided a few years ago to use 4-letter codes for producers, though I do not think the IHO GI registry has been updated yet.

JW: While this is true for Producer Codes, does this also need to be extended to be a requirement for the Exchange Catalogue identifier?

Deleted: The file name must be unique. Each metadata file name must have a MD prefix added to the S-101 dataset file name.¶
Dataset:¶
101GB0045678.000¶
Metadata:¶
MD_101GB0045678_000.xml¶
Update 1:¶
101GB0045678.001¶
Metadata:¶
MD_101GB0045678_001.xml

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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
datasetID	Dataset ID expressed as a Marine Resource Name	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_DigitalSignatureReference (see S-100 Part 15)	
digitalSignatureValue	Value derived from the digital signature	1..*	S100_DigitalSignatureValue (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-101
purpose	The purpose for which the dataset has been issued	1	S100_Purpose	0..1 multiplicity in S-100 restricted to 1 in S-101

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Commented [TR125]: Consider change to 0,1?
Commented [JW126]: Raphael review 29/06/22: In...
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Name	Description	Mult	Type	Remarks
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)	
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-101
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-101
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-101

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Commented [JW127]: AU: The use of the metadata attribute **notForNavigation** is somehow controversial.
- If we are to accept TRUE values, then this should interact with the navigation systems and trigger a pop up message when loading the dataset and an indication on the screen when the product is displayed.

Message example
Product 101AU_SYDNEY_ has been identified as 'NOT FOR NAVIGATION" by the data producer and therefore it can only be used for other purposes (i.e training, planning). ...

Commented [TR128]: Always true?

Commented [TS129R128]: Should always be False I think.

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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 Producer Code from S-62	1	CharacterString	0..1 multiplicity in S-100 restricted to 1 in S-101
encodingFormat	The encoding format of the dataset	1	S100_EncodingFormat	For S-101 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-101
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

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Commented [JW130]: Raphael review 29/06/22: Does S-101 need temporal extent at all?

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Deleted: or¶ CI_Responsibility>CI_Individual

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Commented [TR131]: Still needed and codelist remains in part 17 propose move data coverage?

Deleted: maximumDisplayScale ...

Commented [TS132]: Email from Dave grant 11/09/20.

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Name	Description	Mult	Type	Remarks
replacedData	If a data file is cancelled is it replaced by another data file	0..1	Boolean	*True* indicates the cancelled dataset is to be replaced *False* indicates the cancelled dataset is not to be replaced
dataReplacement	Cell name	0..*	CharacterString	A dataset may be replaced by 1 or more datasets
navigationPurpose	Classification of intended navigation purpose (for Catalogue indexing purposes)	1	S100_NavigationPurpose	0..3 multiplicity in S-100 restricted to 1 in S-101
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

12.1.2.1 S100_NavigationPurpose

Role Name	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	-

12.1.2.2 S100_DataCoverage

Name	Mult	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	0..1		Integer	Example: A scale of 1:22000 is encoded as 22000

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Commented [JW133]: Raphael review 29/06/22: Again, there should be a reference to S-100 17-4.9 and some general guidance on when to use this attribute, especially given that there is a temporalExtent in the dataset discovery metadata block too

Commented [JW134]: AU: Is the use of **optimumDisplayScale** necessary? We thought it was discontinued. Is it expected to be used somehow by ECDIS??? Review the need for **optimumDisplayScale.**
We only found references (2) to this term in DCEG 1.0.2 when it talks of **spanOpen** and **spanClosed** (not sure it should be referenced at all though).

IHO Sec: ENC Scales and dataset load/unload Sub-Group discussions: Retain as optional for testing purposes in Edition 1.1.0. **To be discussed.**

NIWC: Example should use a valid scale.
Should restrict the value domain of optimumDisplayScale to match min/max display scale.

Commented [TS135]: Dataset Scales and Dataset Load and Unload meeting 19/10/22 and subsequent discussion with T ...

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maximumDisplayScale	1		Integer	Must be one of the following values: 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-101
minimumDisplayScale	1		Integer	Must be one of the following values: 2000 3000 4000 8000 12000 22000 45000 90000 180000 350000 700000 1500000 3500000 10000000 NULL 0..1 multiplicity in S-100 restricted to 1 in S-101

Commented [JW136]: NIWC: Disagrees with table 1-3 where 1,000 is included.

IHO Sec: **Agree.** Suggest that Table 1-3 is amended to have 1000 prohibited as a value for minimumDisplayScale (do not think it is appropriate to have a datatset that has both scales set to 1000?). **To be discussed.**

12.1.2.3 S100_Purpose

Role Name	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

Role Name	Name	Description	Code	Remarks
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_VerticalAndSoundingDatum

Role Name	Name	Description	Code	Remarks
Enumeration	S100_VerticalAndSoundingDatum	Allowable vertical and sounding datums	-	Values listed in S-100 Part 17 but not mentioned in this table are not allowed.
Value	meanLowWaterSprings		1	(MLWS)
Value	meanLowerLowWaterSprings		2	
Value	meanSeaLevel		3	(MSL)
Value	lowestLowWater		4	
Value	meanLowWater		5	(MLW)
Value	lowestLowWaterSprings		6	
Value	approximateMeanLowWaterSprings		7	
Value	indianSpringLowWater		8	

Commented [JW137]: Raphael review 29/06/22: I assume this is included because the ISO 8211 file needs it, even though there are no longer vertical/sounding fields in the exchange catalog?

NIWC: This is not used by the 8211 encoding and is unreferenced. See S-100 5.0 10a-5.2.2.6:

10a-5.2.2.6 Vertical Datum field structure

Field Tag: **VDAT**	Field Name: Vertical Datum

Subfield name	Label	Format	Subfield content and specification
Datum Name	DTNM	A()	Name of the Vertical datum
Datum Identifier	DTID	A()	Identifier of the datum in an external sou
Datum Source	DTSR	b11	(1) - IHO CRS Register (2) - Feature Catalogue (3) - EPSG (254) - Other Source (255) - Not Applicable
Datum Source Information	SCRI	A()	Information about the CRS source if DT

IHO Sec: **To be discussed.**

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Value	lowWaterSprings		9	
Value	approximateLowestAstronomicalTide		10	
Value	nearlyLowestLowWater		11	
Value	meanLowerLowWater		12	(MLLW)
Value	lowWater		13	(LW)
Value	approximateMeanLowWater		14	
Value	approximateMeanLowerLowWater		15	
Value	meanHighWater		16	(MHW)
Value	meanHighWaterSprings		17	(MHWS)
Value	highWater		18	(HW)
Value	approximateMeanSeaLevel		19	
Value	highWaterSprings		20	
Value	meanHigherHighWater		21	(MHHW)
Value	equinoctialSpringLowWater		22	
Value	lowestAstronomicalTide		23	(LAT)
Value	localDatum		24	
Value	internationalGreatLakesDatum1985		25	
Value	meanWaterLevel		26	
Value	lowerLowWaterLargeTide		27	
Value	higherHighWaterLargeTide		28	
Value	nearlyHighestHighWater		29	
Value	highestAstronomicalTide		30	(HAT)
Value	balticSeaChartDatum2000		44	
Value	internationalGreatLakesDatum2020	The 2020 update to the International Great Lakes Datum, the official reference system used to measure water level heights in the Great Lakes, connecting channels, and the St. Lawrence River system	46	Unlike the previous two IGLDs, this datum update will use a geoid-based vertical datum that will be accessible using global navigation satellite systems (GNSS) such as the Global Positioning System (GPS)

NOTE 1: The numeric codes are the codes specified in the IHO GI Registry for the equivalent listed values of the IHO Hydro domain attribute *Vertical datum,* since the Registry does not at present (June 2022) contain entries for Exchange Set metadata and dataset metadata attributes.

NOTE 2: This enumeration is not depicted in Figure 12-3 because it is not used in the Exchange Catalogue. The table is retained because the encoding format uses it.

12.1.2.6 S100_EncodingFormat

Role Name	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		

12.1.2.7 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	Electronic Navigational Chart 0..1 multiplicity in S-100 restricted to 1 in S-101
Attribute	version	The version number of the Product Specification	1	CharacterString	1.1.0 0..1 multiplicity in S-100 restricted to 1 in S-101
Attribute	date	The version date of the Product Specification	1	Date	0..1 multiplicity in S-100 restricted to 1 in S-101
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-101" (without quotes)
Attribute	number	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 (GI) 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-101. Needed for S-98 interoperability

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Commented [JW138]: Lloyds Register: According to the clause 4.3.1 FC can downloaded from IHO GI register site. The we need to know the version. Each FC has own version number, for example <S100FC:versionNumber>1.0.2</S100FC:versionNumber>. For Prod.Spec. S-101 ver.1.0.0 we have had FC versions 1.0.0, 1.0.1 and 1.0.2 .
To avoid conflict during data loading, we have to indicate the applied FC version for each dataset in the S100_ProductSpecification type. Otherwise, we are forced to include to exchange set a new standard revision(clarification) FC.
We suppose it doesn't make sense to include a new standard FC revision(clarification) to each exchange set. It is enough if a supplier of data indicates which standard version of FC must be applied with delivered dataset. We suggest to add a new attribute featureCatalogueVersion to the S100_ProductSpecification type.
Add a new row with attribute featureCatalogueVersion, see below:

IHO Sec: **To be discussed.** A new version of a FC should result in a NE of the PS (perhaps needs to be discussed in regards to very minor corrections?) so consider probably not required.

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Commented [JW139]: 7Cs: If always '2', why not enter it here as default value?

IHO Sec: This is still under discussion in the GI Registry development team and will likely need to be confirmed within the S-100WG (for example, does a New Edition of a PS get a new unique ID?). **To be discussed.**

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12.1.2.8 S100_CompliancyCategory

Role Name	Name	Description	Code	Remarks
Enumeration	S100_CompliancyCategory		-	All S-101 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)
Value	category3	IHO S-100 compliant with standard encoding		
Value	category4	IHO S-100 and IMO harmonized display compliant		

12.1.2.9 S100_ProtectionScheme

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

12.1.3 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 Part1, 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-101
dataType	The format of the support file	1	S100_SupportFileFormat	

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Commented [JW140]: 7Cs: For example new, replacement, etc.
Add '.' after etc.

IHO Sec: **Not applied**. IHO convention is to not include a period at the end of an abbreviation.

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Deleted: When a support file is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition of the support file. Characters forming the editionNumber must be integers from 0 to 9

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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 digitalSignatureValue	1	S100_DigitalSignatureReference (see Part 15)		
digitalSignatureValue	Value derived from the digital signature	1..*	S100_DigitalSignatureValue (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 still to be developed and will be defined later	
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-101.

12.1.3.1 S100_SupportFileFormat

Role Name	Name	Description	Code	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	ASCII	UTF-8 text excluding control codes	1	Text
Value	JPEG2000	JPEG2000 format	2	ISO 15444
Value	HTML	Hypertext Markup Language	3	
Value	XML	Extensible Markup Language	4	
Value	TIFF	Tagged Image File Format	7	

12.1.3.2 S100_SupportFileRevisionStatus

Role Name	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

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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

12.1.3.3 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	

Commented [JW141]: 7Cs: If the support file specification is S-101, this could be added here as default values. This applies also to other items throughout the document.

IHO Sec: **To be discussed.**

12.1.3.4 S100_ResourcePurpose

Role Name	Name	Description	Code	Remarks
Enumeration	S100_ResourcePurpose	Defines the purpose of the supporting resource	-	-
Value	dataset	A dataset	1	
Value	featureCatalogue	A Feature Catalogue for an S-100 data product	2	
Value	portrayalCatalogue	A Portrayal Catalogue for an S-100 data product	3	
Value	interoperabilityCatalogue	An Interoperability Catalogue	4	
Value	supportFile	A support file	5	
Value	productVersion	All datasets conforming to a specific version of an S-100 Product Specification	6	
Value	productFamily	All datasets conforming to any active version of an S-100 Product Specification	7	
Value	software	Application software	8	
Value	system	Provides support or common information for a variety of applications and products	9	
Value	exchangeCatalogue	An Exchange Catalogue	10	
Value	ISO Metadata	Dataset metadata in ISO format	11	
Value	Language Pack	A Language pack	12	

Value	GML Schema	GML Application Schema	13		
Value	other	A type of resource not otherwise described	100		

12.1.4 S100_CatalogueDiscoveryMetadata

This is an optional element that allows for the delivery of S-101 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_DigitalSignatureReference (see Part 15)	Reference to the appropriate digital signature algorithm
digitalSignatureValue	Value derived from the digital signature	1..*	S100_DigitalSignatureValue (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-101
otherLocale	Other languages and character sets used in the Catalogue	0..*	PT_Locale	

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12.1.4.1 S100_CatalogueScope

Role Name	Name	Description	Code	Remarks
Enumeration	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	

12.1.4.2 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

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12.1.4.3 MD_MaintenanceFrequencyCode

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

Role Name	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

12.1.4.4 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.

Deleted: Use (the “Name” from the) IANA Character Set register: http://www.iana.org/assignments/character-sets. (ISO 19115-1 B.3.14)¶
For example, UTF-8

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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 **feature name**.

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 ENC 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-101 encoding to meet IHO standards for the proper display of ENC in an S-100 based marine navigation system such as ECDIS. The document describes how to encode information that the cartographer considers relevant to an ENC. The content of an ENC is at the discretion of the Producing 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 ENCs.

The S-101 Data Classification and Encoding Guide can be found in the Standards and Publications page of the IHO web site, http://www.iho.int.

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ANNEX B (Normative) - Data Product format (encoding)

Commented [JW143]: Changes to this Annex applied iaw Holger review 24/06/22

Introduction

S-101 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-101.

B-1 Dataset Files

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

Dataset file
- Dataset General Information record
- Dataset Coordinate Reference System record
- Information Type records
- Point records
- Multi Point records
- Curve records
- Composite Curve records
- Surface records
- Feature Type records
  - Meta features
  - Geo features
  - Aggregated features

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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).

Commented [JW144]: Lloyds Register: According to the spatial model a composite curve can refer to other composite curves. Does it mean that the order of composite curves records must correspond to the statement of the last paragraph of the clause, i.e. child records are before a parent record? If so, it should be indicated for composite curve records

IHO Sec: Not sure what is intended here (one for Holger?). **To be discussed.**

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) subfield must be set to “Insert”. When encoding updates RUIN may be set to “Insert”, “Modify” or “Delete”.

B-5 Base Dataset Structure

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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): 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
   |
   |
   |--<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 Type 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 (1): 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
|       |
|       |-<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
       |
       |-<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 Set 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	"5.0"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-101.1.1"	A()	Unique identifier for the data product as specified in the Product Specification
Product edition	PRED	"1.1"	A()	Edition of the Product Specification
Application profile	PROF	"1"	A()	"1" – Base dataset profile
Dataset file identifier	DSNM		A()	The file identifier 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	{10}	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

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Commented [JW145]: NIWC: A() format syntax is not consistently applied and is also wrong in S-100 which now shows up wrong in a product spec. I believe this is the proper syntax for variable character array in 8211. But see table on next page, B-4.1.3, where it is just A vs A()

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B-5.1.3 Attribute Code field structure - ATCS

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

Commented [TS146]: NIWC: Matching of array indicator from S-100 spec (throughout).

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 Feature Catalogue
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 Feature Catalogue
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 Feature Catalogue
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 Feature Catalogue
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 Feature Catalogue
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

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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 CRSs
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()	

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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	{11} – for vertical datum {12} – for sounding datum	b11	{11} – Gravity related depth (orientation up) {12} – Gravity related depth (orientation down)
Axis Unit of Measure	AXUM	{4}	b11	{4} – Metre

Commented [JW147]: NIWC: Need to also allow {11} for vertical datum ({12} only applies to sounding datum)

Lloyds Register: See comment above. to fix the B5.1.11 table where the value of Axis Type (AXTY) sub-field can be equal to {11} or {12} for vertical datum or sounding datum correspondingly.
Replace the cell "Value" with: {11} or {12}
Insert to the cell "Comment": {11} - Gravity Related Height

IHO Sec: Have added information related to a new entry for {11} to facilitate discussion. **To be discussed.**

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 vertical datum
Datum Identifier	DTID		A()	Identifier of the datum in an external source
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

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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

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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 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
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

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Commented [JW148]: DE: See B-6.1.11
Add “b12” in column “Format”

IHO Sec: **Applied.**

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{2} – Delete¶
{3} – Modify

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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

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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 or latitude
Coordinate in X axis	XCOO		b24	X-coordinate or 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 or latitude
Coordinate in X axis	XCOO		b24	X-coordinate or 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

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B-5.1.20 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

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)

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

Deleted: Name
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B-5.1.23 Point Association field - PTAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM	{110}	b11	Record name of the referenced record {110} – Point
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

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Deleted: Identifier
Deleted: Indicator

B-5.1.24 Segment Header field - SEGH

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

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

Deleted: Name
Deleted: Identification
Deleted: Version
Deleted: Update
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B-5.1.26 Curve Component field - CUCO

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
Orientation	ORNT		b11	{1} – Forward

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				{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	{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
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)

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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 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}	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
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above

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{2} – Delete¶
{3} – Modify

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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 data coverage limit {2} – Suppress portrayal
Mask Update Instruction	MUIN	{1}	b11	{1} – Insert

Deleted: Name

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Commented [JW149]: Lloyds Register: The value {1} is defined as "Truncated by the dataset limit" in the Comment cell. We think it will be more correct to consider data coverage limits of the dataset. The current definition could be interpreted as limits of the bounding box of the dataset. The current document does not contain any specification to the rule of encoding Truncated limits of the areas in the clause 4.8.2. Masking.
The clause 2.5.10 of DCEG mention masking of the edges where they share "the geometry of the boundary in each ENC". We think it would be better to use data coverage boundary/limit.
The value {2}: Fix spelling of supress
Replace: "Truncated by the dataset limit"
With: "Truncated by the data coverage limit"
Remark DCEG the clause 2.5.10 that the truncated indicator should be assigned to a curve shared by the data coverage feature.
IF: It tells that this might be done manually
{2} : Supress → suppress
(The same fixes must be done in B-6.1.xx)

IHO Sec: **Applied.** However am a little concerned that this change opens the door on adjoining data coverage limits within the same dataset. **To be discussed.**

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B-6 Update Dataset Structure

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```
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 Type 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
   |      |
   |      *-<0..1>-C2IT (2): 2-D Integer Coordinate Tuple field
   |      |
   |      *-<0..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
|       |
|       |-<0..1>-PTAS (*3): Point Association field
|       |
|       |-<0..1>-SECC (3): Segment Control field
|       |
|       |-<0..1>-SEGH (1): Segment Header field
|           |
|           |-<0..1>-COCC (3): Coordinate Control 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
|       |
|       |-<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
|       |
|       |-<0..*>-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): Feature Association field
|
|-<0..*>-MASK (*4): Masked Spatial Type field
```

B-6.1 Field content

B-6.1.1 Dataset Identification field - DSID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{10}	b11	{10} = Data Set 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	"5.0"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-101.1.1"	A()	Unique identifier for the data product as specified in the Product Specification
Product edition	PRED	"1.1"	A()	Edition of the Product Specification
Application profile	PROF	"2"	A()	"2" – Update dataset profile
Dataset file identifier	DSNM		A()	The file identifier 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()	[edition number].[update number] for example 4.20
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

B-6.1.2 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	{10}	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-6.1.3 Attribute Code field structure - ATCS

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

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Deleted: Edition
Deleted: 0
Deleted: Profile
Deleted: File
Deleted: Identifier
Deleted: name
Deleted: Title
Deleted: Reference
Deleted: Date
Deleted: Language
Deleted: Abstract
Deleted: Edition
Deleted: Topic
Deleted: Category
Deleted: Multiplication
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Deleted: X
Deleted: Multiplication
Deleted: Factor
Deleted: Y
Deleted: Multiplication
Deleted: Factor
Deleted: Z
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B-6.1.4 Information Type Codes field structure - ITCS

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

B-6.1.5 Feature Type Codes field structure - FTCS

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

B-6.1.6 Information Association Codes field structure - IACS

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

B-6.1.7 Feature Association Codes field structure - FACS

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

B-6.1.8 Association Role Codes field structure - ARCS

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

B-6.1.9 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},{2} or {3}	b11	{1} – Insert {2} – Delete {3} – Modify

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Deleted: Version
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B-6.1.10 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

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Attribute instruction	ATIN	{1}, {2} or {3}	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

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B-6.1.11 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 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 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		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

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B-6.1.12 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},{2} or {3}	b11	{1} – Insert {2} – Delete {3} – Modify

Deleted: Name

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Deleted: Version

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B-6.1.13 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

B-6.1.14 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)

B-6.1.15 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},{2} or {3}	b11	{1} – Insert {2} – Delete {3} – Modify

B-6.1.16 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

B-6.1.17 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)

B-6.1.18 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

B-6.1.19 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

B-6.1.20 Point Association field - PTAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM	{110}	b11	Record name of the referenced record {110} – Point
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

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Deleted: Version
Deleted: Update
Deleted: Instruction
Deleted: Name
Deleted: Identifier
Deleted: Indicator

B-6.1.21 Segment Control field - SECC

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

Deleted: Update
Deleted: Instruction
Deleted: Index
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B-6.1.22 Segment Header field - SEGH

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

B-6.1.23 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},{2} or {3}	b11	{1} – Insert {2} – Delete {3} – Modify

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B-6.1.24 Curve Component Control field - CCOC

Subfield name	Label	Value	Format	Comment
Curve Component update instruction	CCUI		b11	{1} – Insert {2} – Delete {3} – Modify
Curve Component Index	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

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B-6.1.25 Curve Component field - CUCO

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
Orientation	ORNT		b11	{1} – Forward {2} – Reverse

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B-6.1.26 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},{2} or {3}	b11	{1} – Insert {2} – Delete {3} – Modify

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B-6.1.27 Ring Association field - RIAS

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
Orientation	ORNT		b11	{1} – Forward {2} – Reverse
Usage indicator	USAG		b11	{1} – Exterior {2} – Interior
Ring Association update instruction	RAUI	{1} or {2}	b11	{1} – Insert {2} – Delete

B-6.1.28 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},{2} or {3}	b11	{1} – Insert {2} – Delete {3} – Modify

B-6.1.29 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-6.1.30 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} or {2}	b11	{1} – Insert {2} – Delete

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B-6.1.31 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 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 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},{2} or {3}	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

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B-6.1.32 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 data coverage limit {2} – Suppress portrayal
Mask Update Instruction	MUIN	{1} or {2}	b11	{1} – Insert {2} – Delete

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Commented [JW150]: See Lloyds Register comment for clause B-5.1.33.

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B-7 Dataset Cancellation Structure

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```
Dataset cancelation file
   |
   |--<1>- Dataset General Information record

       |

       |--<1>-DSID (13\\*1): Dataset Identification field
```

B-7.1 Field content

B-7.1.1 Dataset Identification field - DSID

Subfield name	Label	Value	Format	Comment
Record name	RCNM	{10}	b11	{10} – Data Set 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	"5.0"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-101.1.1"	A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED	"1.1"	A()	Edition of the product specification
Application profile	PROF	"2"	A()	"2" – Update dataset profile
Dataset file identifier	DSNM		A()	The file identifier 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 cancellation
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

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ANNEX C - S-101 Validation Checks

This Annex specifies the minimum checks that producers of S-101 ENC validation tools should include in their validation software. This software must be used by Hydrographic Offices to help ensure that their ENC data are compliant with the S-101 ENC 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 provides checks for individual ENC cells however additional checks applicable to ENC Exchange Sets are included in part X.X.

The S-101 Validation Checks can be found in the Standards and Publications page of the IHO web site, www.iho.int.

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