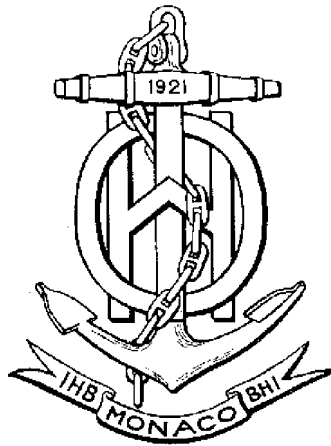


INTERNATIONAL HYDROGRAPHIC ORGANIZATION



IHO ELECTRONIC NAVIGATIONAL CHART PRODUCT SPECIFICATION

July 2014

IHO Publication S-101
Electronic Navigational Chart Product Specification

NOTE: S-101 has various components that are in development. Therefore until it is at a final draft stage various items such as the main document, feature catalogue and data classification and encoding guide are not fully harmonized.

**Published by the
International Hydrographic Bureau
MONACO**

Version Number	Date	Author	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	J.Powell	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.

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Introduction

S-101 is the Electronic Navigational Chart 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 without breaking system implementations.

Based on S-100, S-101 includes all the necessary pieces for both Hydrographic offices to produce Electronic Navigational Charts (ENC) and OEMs to be able to ingest and properly display them. This product specification is designed to be flexible with the introduction of machine readable feature and portrayal catalogues that will allow for managed change and will enable the introduction of new navigationally significant features and their portrayal using a “just in time” methodology.

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 ECDIS. It specifies the content, structure, and metadata needed for creating a fully compliant S-101 ENC and for its portrayal within an S-100 ECDIS. This product specification includes the content model, the encoding, the feature catalogue, portrayal catalogue and metadata.

1.2 References

S-100 IHO Universal Hydrographic Data Model

FIPS 186 Federal Information Processing Standards – Digital Signature Standard

1.3 Terms, definitions and abbreviations

1.3.1 Use of Language

Within this document:

“Must” indicates a mandatory requirement.

“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

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 alarms, alarms, warnings and cautions. An alert provides information about a defined state change in connection with information about how to announce this event in a defined way to the system and the operator

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.

CIE Colours

One of the first mathematically defined colour spaces the CIE XYZ colour space was created by the International Commission on Illumination 1931.

Colour Token

A five letter, code identifying a colour and its use in ECDIS. The day and night colours which are identified by the token are given in the colour tables (in CIE coordinates). Note that several colour tokens **may** share the same colour.

Complex Line Styles

Lines that are themselves symbols, or that have symbols interlaced. Examples of a line as a symbol are a submerged pipeline LC(PIPSOL05), or the T T T lines indicating the inside of an area

LC(ENTRES51). A simple or complex line **may** have a symbol interlaced, such as an anchor for anchorage area LC(ACHARE51).

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.

Display Category

IMO PS [2] establishes three display categories for the presentation of SENC objects Display base: always on the display. Standard display the ECDIS' default display. Other: all other objects in the SENC.

Display Priority

Hierarchy to decide which object is to be shown when two objects overlap. Priority 2 overwrites 1

ECDIS

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

ECDIS Chart 1

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

ENC

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

Feature

Abstraction of real world phenomena [ISO 19101:2003]

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

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

Geometric Primitive

A plain point, a plain curve, a plain surface as defined in geometry (i.e. without any meaning attached).

Indication

Visual indication giving information about the condition of a system or equipment. [2]

Minimum Display Scale

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.

Maximum Display Scale

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.

No symbol Object

In some cases, the database contains information that is not intended for display. (An example might be a general area such as 'Great Australian Bight' which would be available for an answer to cursor interrogation of the sea area.)

Opaque fill

The background is completely filled with the colour fill. (e.g. depth area). The point and line SENC features **may** be overwritten. The raw RADAR image is a special case of opaque fill which overwrites all other features except those with "priority over radar" (OVERRADAR).

Pattern fill

A method of identifying areas by large, faintly coloured symbols well spaced out across the area. A pattern spacing algorithm ensures that the pattern symbols are visible without being so dense as to cause clutter. Used to ensure pattern symbols are always visible at any display scale.

Pivot Point

The pivot point is the point around which the symbol gets scaled and rotated. When the symbol is placed in the world space, the symbol's pivot point is positioned exactly on the object's position and all elements of the symbol are geometrically related to that position.

Radar Priority

IMO PS [2] requires that radar can be switched off with a "single action control" in order to see SENC and Mariners info clearly. However certain other info, such as planned route, safety contour, coastline shall 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 object it overlays at each pixel

SCAMIN

The smallest scale at which an object is displayed (e.g. a minor light, SCAMIN of 1:45,000, would not be displayed at a scale of 1:90,000).

Simple Line Styles

Solid lines, dots and dashes.

Skin of the EARTH

The skin of the earth comprises of a set of non-overlapping features of type area.

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 specified in PC&SS [5] and S-52 [3].

Symbology Instruction

A machine readable symbolization order used in look-up tables to link object-classes to symbols, in straight forward cases (i.e. where a conditional symbology instruction is not required)

Text Label

A textual description of an object. 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 areas 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.

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
ECDIS	Electronic Chart Display Information System
EPSG	European Petroleum Survey Group
ENC	Electronic Navigational Chart
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization
SENC	System Electronic Navigational Chart
SOLAS	Safety of Life at Sea

1.4 S-101 General Data Product Description

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. Its primary purpose is for use within an Electronic Chart Display and Information Systems (ECDIS) to meet International Maritime Organization (IMO) and Safety of Life at Sea (SOLAS) chart carriage requirements. 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 to an Electronic Chart Display and Information System (ECDIS) 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: 1.0.0

S-101 Version: 0.0.1

Date: December 2013

Language: English

Classification: Unclassified

Contact: International Hydrographic Bureau (IHB)

4 Quai Antoine 1er
B.P. 445
MC 98011 MONACO CEDEX
Telephone: +377 93 10 81 00
Fax: + 377 93 10 81 40

URL: www.iho.int

Identifier: S-101

Maintenance: Changes to the Product Specification S-101 are coordinated by Transfer Standards Maintenance and Applications Development Working Group (TSMAD) of the IHO and must be made available via the IHO web site. Maintenance of the Product Specification must conform to IHO Technical Resolution 2/2007 (revised 2010).

1.5.1 IHO Product Specification Maintenance

1.5.1.1 Introduction

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

1.5.1.2 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.

1.5.1.3 Revisions

Revisions are defined as substantive semantic changes to S-101. Typically, revisions will change S-101 to correct factual errors; introduce necessary changes that have become evident as a result of practical experience or changing circumstances. A *revision* must not be classified as a clarification. *Revisions* could have an impact on either existing users or future users of S-101. All cumulative *clarifications* must be included with the release of approved corrections revisions.

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

In most cases a new feature catalogue or portrayal catalogue will result in a revision of S-101.

1.5.1.4 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 within the same Edition. Within the same Edition, a dataset of one clarification version could always be processed with a later version of the feature and portrayal catalogues, and a portrayal catalogue can always rely on earlier versions of the feature catalogues.

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

1.5.1.5 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 Scopes

Scope ID: Root scope

Level: Dataset

Level name: ENC Dataset

3 Dataset Identification

A dataset that conforms to this Product Specification may be identified by its discovery metadata.

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 in an ECDIS to satisfy IMO Performance Standards for ECDIS.
Topic Category:	Transportation (ISO 19115 Domain Code 018)
Geographic Description:	Areas specific to marine navigation.
Spatial Resolution:	An ENC dataset must carry values for minimum and maximum display scale. These define a scale range within which the dataset should be used. Values must be taken from the following table:

Scale
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

Table 1- ENC Minimum Display and Maximum Display Scales

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: Unclassified Restricted Confidential

Secret
Top Secret

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. It is also available in a human readable version.

4.3.2 Feature Types

4.3.2.1 Geographic

Geographic (geo) feature types form the principle 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 **DataCoverage** 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:

DepthArea

DredgedArea

LandArea

UnsurveyedArea

DockBasin

LockBasin

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

4.3.2.2 Meta

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

4.3.2.3 Cartographic

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

4.3.3 Feature Relationship

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

4.3.3.1 Information Association

An association is used to describe a relationship between an information type and a feature type that involves connections between their instances.

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

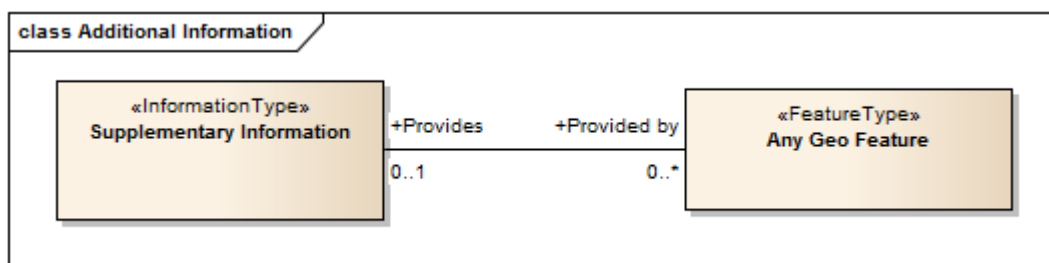


Figure 1 - Information Association

4.3.3.2 Feature Association

An 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.

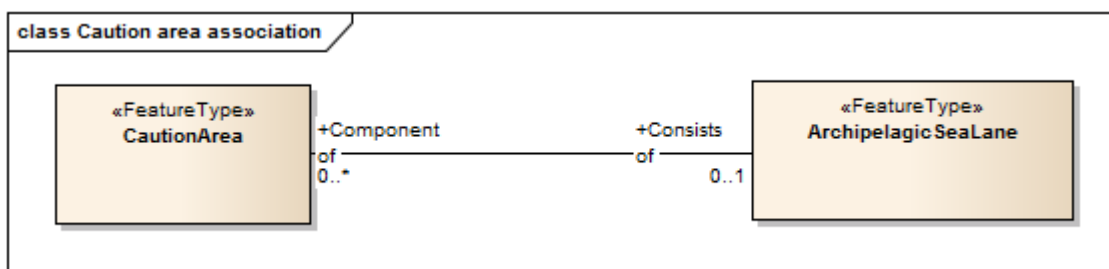


Figure 2 – Feature Association

4.3.3.3 Aggregation

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

EXAMPLE An **IslandGroup** feature may be composed of multiple **LandArea** features to indicate the name of a group of island.

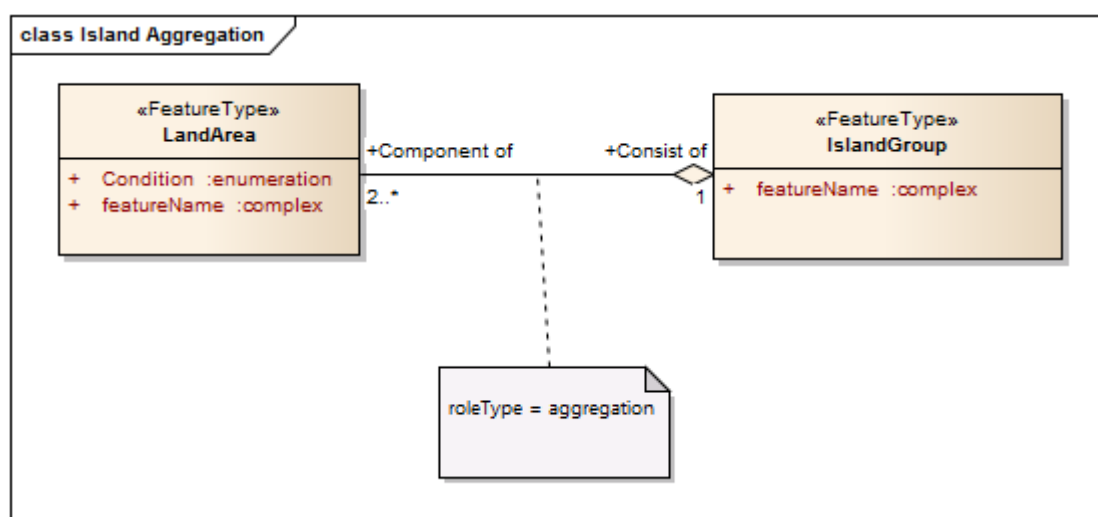


Figure 3 - Aggregation

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.

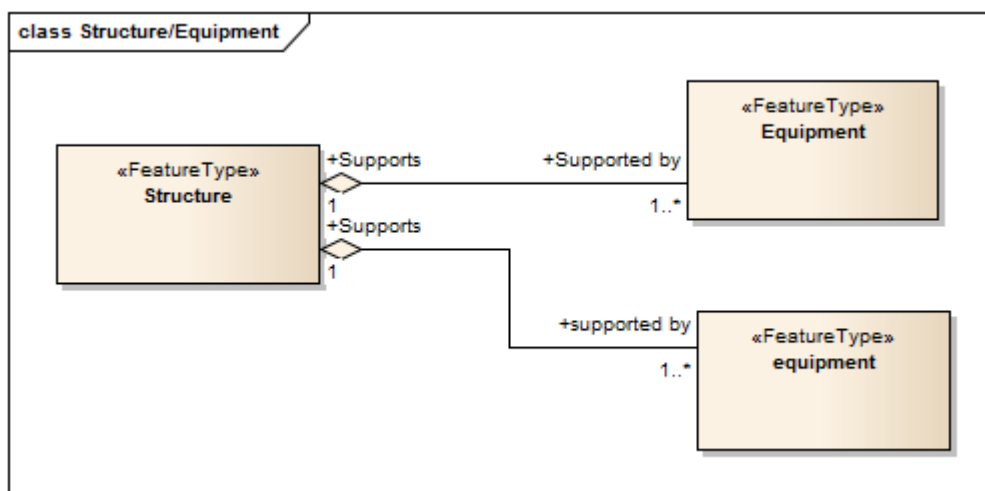


Figure 4 - Composition

4.3.4 Information Types

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

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 is known, therefore this is prohibited. Vertical uncertainty is prohibited for curves as this dimension is not supported by curves.

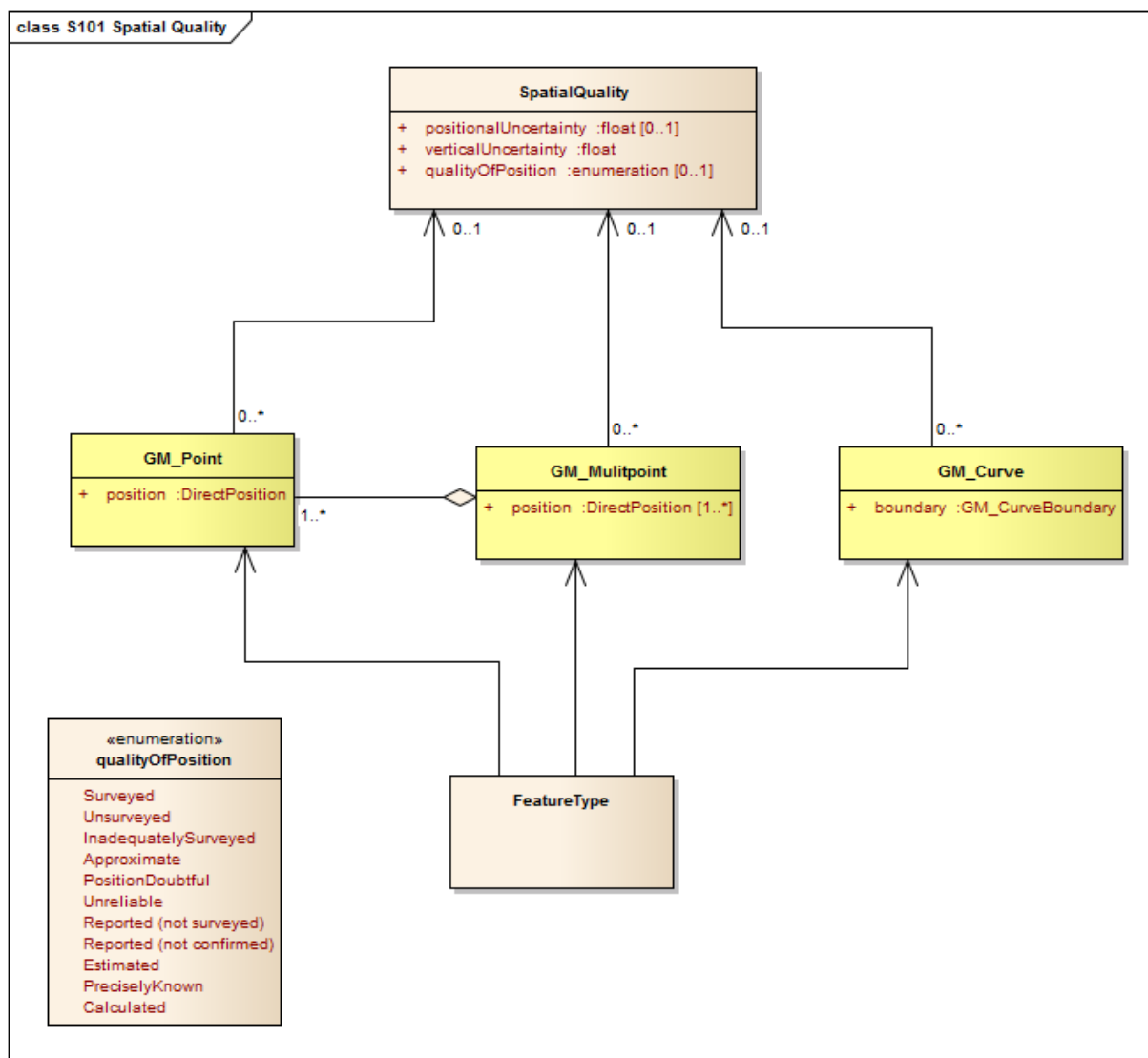


Figure 5 - Spatial Information Type

4.3.5 Attributes

S-101 defines attributes as either simple or complex.

4.3.5.1 Simple Attributes

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

Type	Definition
Boolean	the value is a logical value either 'True' or 'False'
Integer	the value is an integer number
Real	the value is a floating point number
enumeration	the value is one of a list of predefined values.

text	the value is general text. This is also defined as CharacterString.
dateTime	the value marks a point in time, consisting of a date in the Gregorian calendar and a 24 hour time. The time may contain a time zone.
date	the value is a date according to the Gregorian calendar.
time	the value is a 24 hour time, It may contain a time zone.

Table 2 - Simple Attribute Types

4.3.5.2 Complex Attributes

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

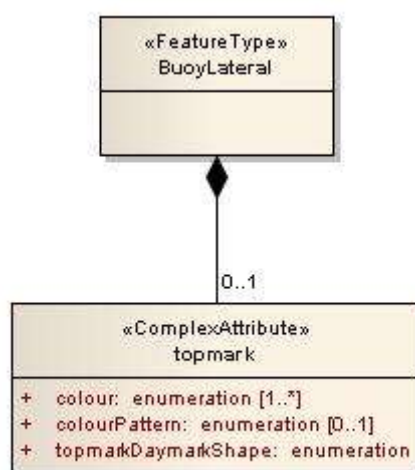


Figure 6 - Complex Attribute

EXAMPLE In this example a **topmark** has three sub attributes. The Buoy Lateral Feature may optionally include one instance of the complex attribute **topmark**.

4.4 Feature Object Identifier

Each real world feature within an ENC must have a unique universal Feature Object Identifier. This identifier, called the feature object 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 cell. This is accomplished in the 8211 encoding by including a Spatial Association for each disjoint component. When a feature’s geometry is split each component must be represented by a separate spatial feature that the feature refers to.

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

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

4.5 Dataset

4.5.1 Introduction

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

4.5.2 Dataset rules

In order to facilitate the efficient processing of ENC data the geographic coverage of a given **maximumDisplayScale** may be split into multiple datasets. Each data set must be contained in a physically separate, uniquely identified file on the transfer medium.

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

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

Datasets must not cross the 180° meridian; this includes both the **DataCoverage** features and the **boundingBox**.

4.5.3 DataCoverage rules

A data set may contain more than one **DataCoverage** feature, but must not contain more than three total **DataCoverage** features. The data boundary is defined by the extent of the **DataCoverage** features and must be contained within the **boundingBox**.

NOTE: Annex CXX.X provides guidance for ENC producers regarding how to create datasets with multiple **DataCoverages**.

Data Sets with the same maximum display scale may overlap, however **DataCoverage** features within these datasets must not overlap. This rule applies even if several producers are involved. There must be no overlapping data of the same maximum display scale, except at the agreed adjoining national data limits, where, if it is difficult to achieve a perfect join, a 5 metre overlapping buffer zone may be used; and for this situation, there must be no gaps in data.

When a dataset has multiple **DataCoverage** features, then the **minimumDisplayScale** must be the same for all **DataCoverage** features within the dataset.

4.5.4 Dataset size

Datasets must not exceed 10MB.

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

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 in and ECDIS) The smallest scale is defined by the **minimumDisplayScale** and the largest scale by the

maximumDisplayScale. These scales must be set at one of the scales specified in clause 3 (spatial resolutions).

When a viewing scale is smaller than the **minimumDisplayScale**, skin of the earth features within the **DataCoverage** feature are not displayed. When the viewing scale is larger than the **maximumDisplayScale**, skin of the earth features within the DataCoverage feature are displayed with over-scale indications. The viewing scale is selected by the mariner as an outside input.

4.7 Dataset Loading and Unloading

A new algorithm based on producer defined display scales (minimum and maximum) for dataset loading and unloading is prescribed in S-101. This will simplify the process for ECDIS, 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 ENC's in a visual catalogue. In order for the appropriate ENC to be viewed at the mariner's selected viewing scale, S-101 prescribes an algorithm for the loading and unloading of ENC's within an ECDIS.

4.7.1 Dataset Loading and Unloading Algorithm

This clause defines the dataset loading and unloading algorithm for use on ECDIS.

ENC data

maximumDisplayScale
minimumDisplayScale

Data Set X
12000
45000

Data Set Y
22000
90000

Data Set Z
45000
180000



Dataset Drawing order on the memory of ECDIS



Condition		Combining Datasets
1	Mariners Selected Viewing Scale (MSVS) = 45000 $\text{maximumDisplayScale}(X,Y,Z) \leq \text{MSVS} \leq \text{minimumDisplayScale}(X,Y,Z)$	
2	MSVS = 90000 $\text{maximumDisplayScale}(Y,Z) \leq \text{MSVS} \leq \text{minimumDisplayScale}(X)$	
3	MSVS = 22000 $\text{maximumDisplayScale}(X,Y) \leq \text{MSVS} < \text{maximumDisplayScale}(Z)$	

* Dataset with the smaller **maximumDisplayScale** is drawn first.

Figure 7 - Data Loading and Unloading Algorithm

In order for ECDIS to properly load and unload data as the mariner is zooming in and out using the mariners selected viewing scale (MSVS) the following algorithm must be used.

1. Create selection List

- a. All **DataCoverage** areas within the graphics window within scale range (covered by the MSVS) are firstly ordered by **maximumDisplayScale** and secondly by the largest percentage of coverage if **DataCoverage** areas have the same **maximumDisplayScale**
 - b. All other smaller scale **DataCoverage** areas within the graphics window are firstly ordered by **maximumDisplayScale** and secondly by the largest percentage of coverage if **DataCoverage** areas have the same **maximumDisplayScale**
 - c. The display order is from the smallest **maximumDisplayScale** to the largest **maximumDisplayScale**, i.e. the **DataCoverage** area with largest **maximumDisplayScale** will be displayed with the highest priority
2. If the MSVS is larger than the **maximumDisplayScale** 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 **maximumDisplayScale**, i.e. MSVS is set to the **maximumDisplayScale** 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 **DataCoverage** with different **maximumDisplayScale** and **minimumDisplayScale**. They are denoted as areas A, B, C and D.

NOTE: this example is applicable to multiple datasets with overlapping **DataCoverages**.

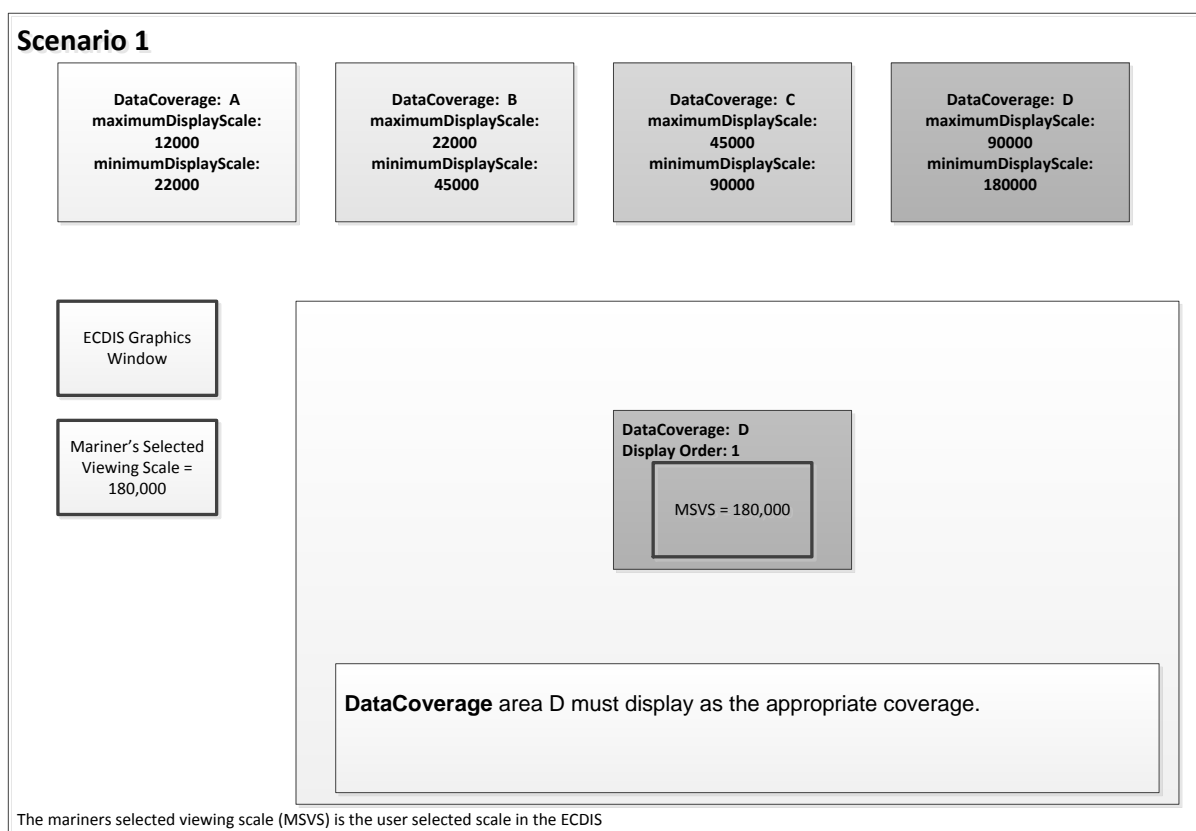


Figure 8 – Scenario 1: Simple DataCoverage Display

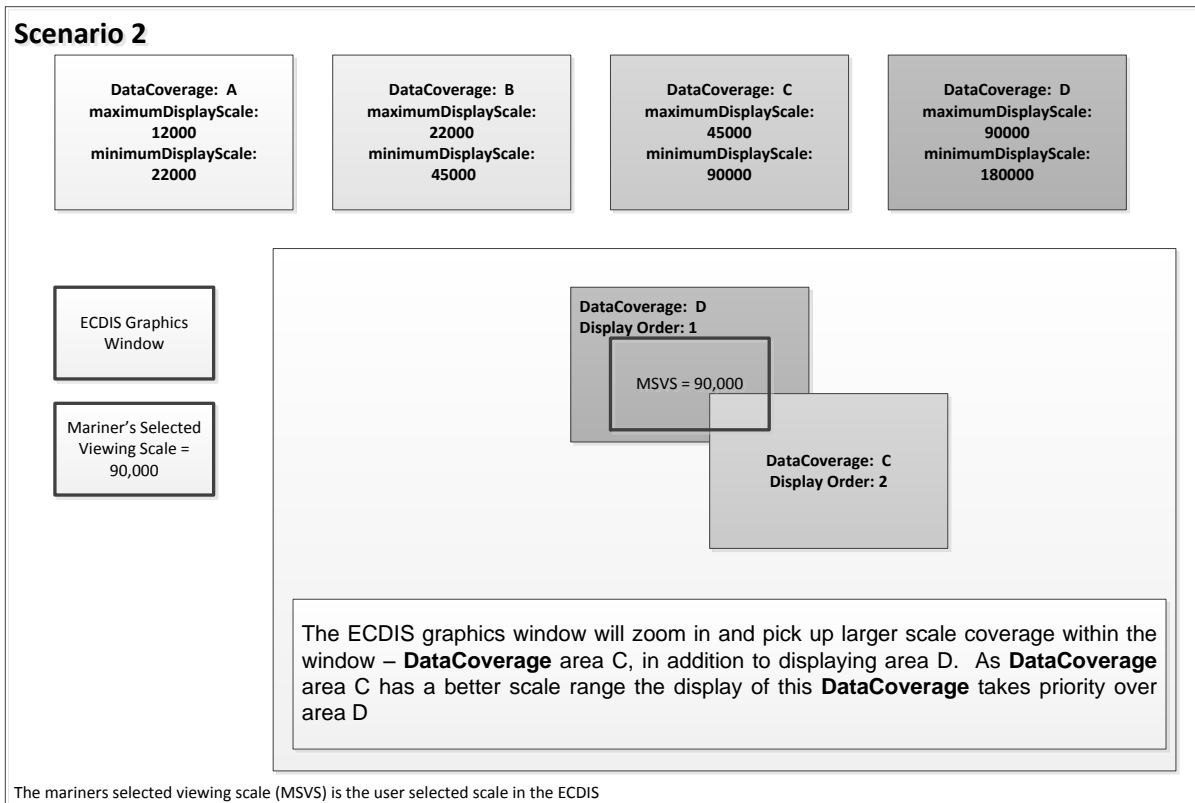


Figure 9 - Scenario 2: Display of two different overlapping DataCoverages

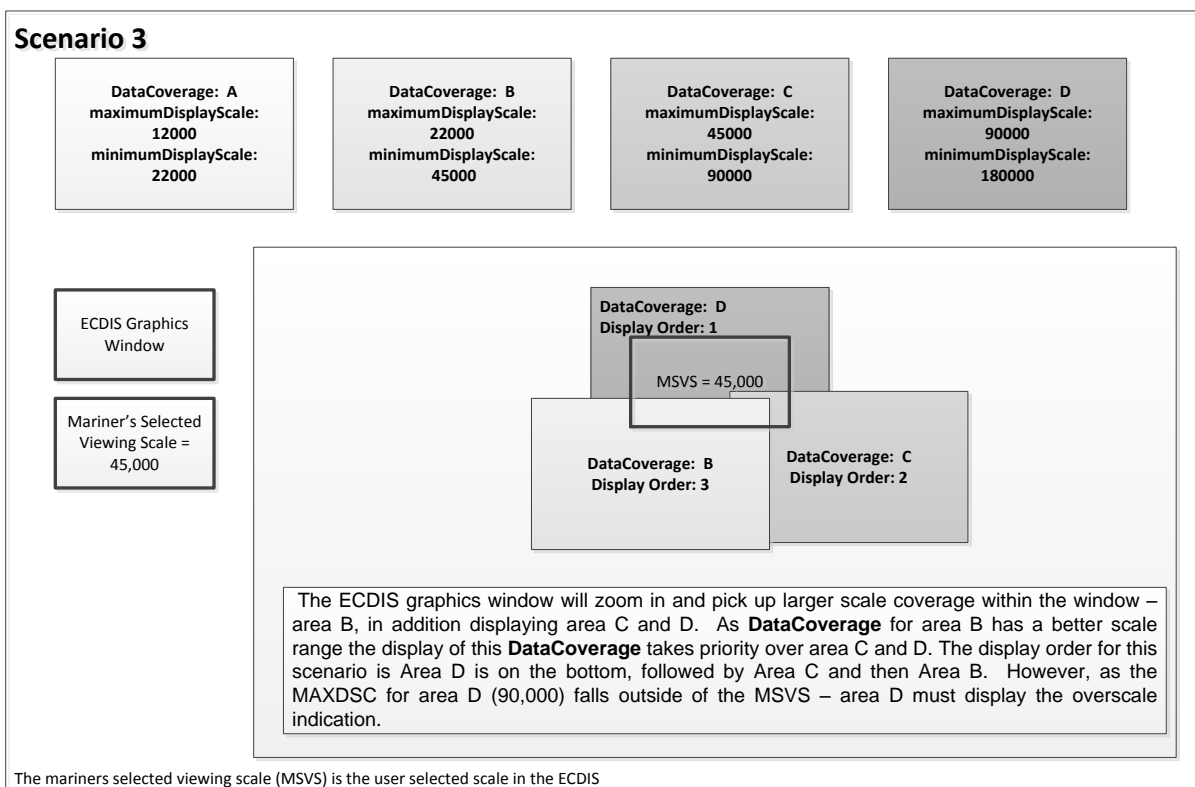


Figure 10 - Scenario 3: Display of three different overlapping DataCoverages

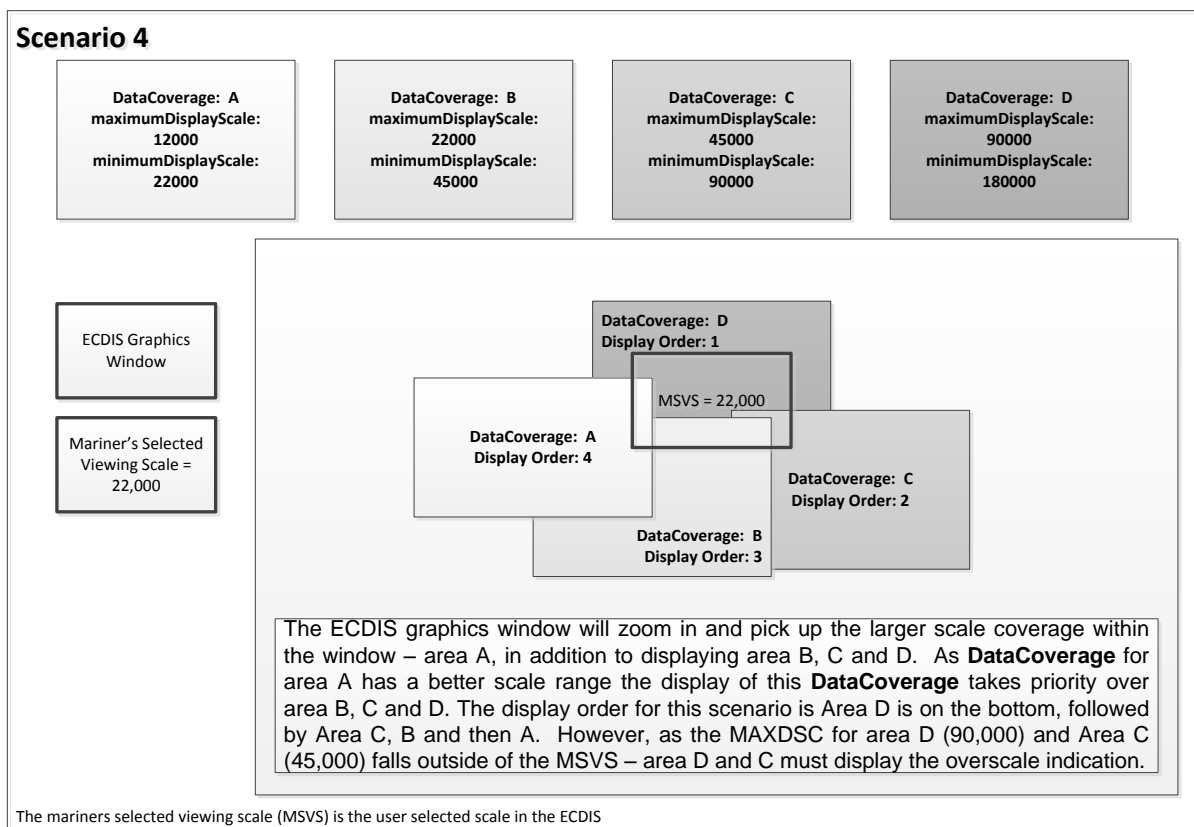


Figure 11 - Scenario 4: Display of four different overlapping coverages

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 12.
- 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 tangentially (i.e. at one point). See Figure 13.
- 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 14.

S-101 further constrains Level 3a with the following:

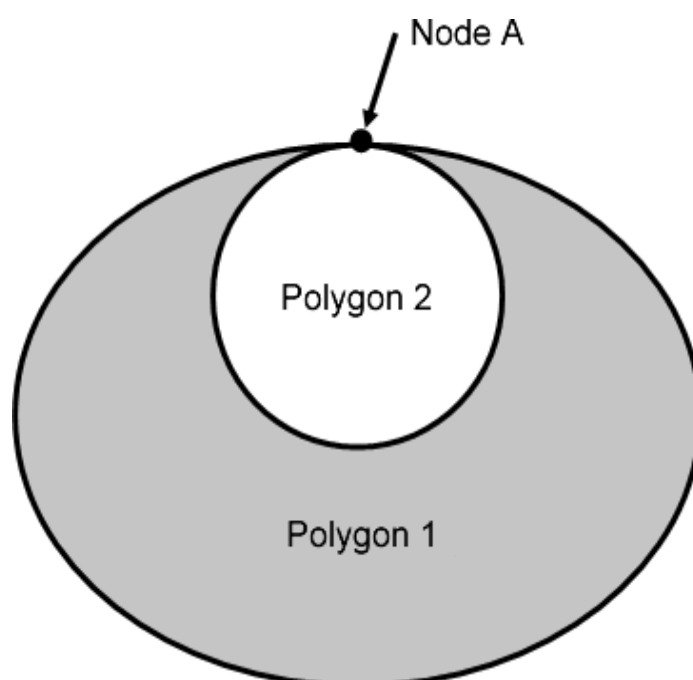
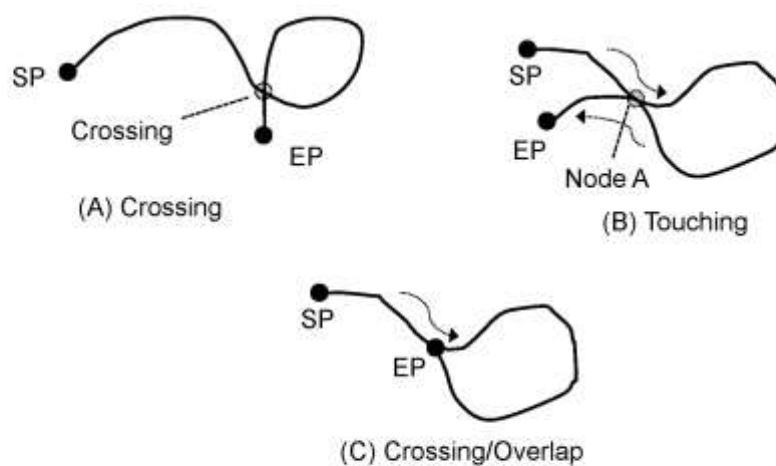
- Coincident linear geometry must be avoided when there is a dependency between features.
- The interpolation of GM_CurveSegment must be loxodromic.

- Linear features must not be encoded with a distance between two consecutive vertices which is smaller than 0.3mm at maximum display scale.

The following exception applies to S-101:

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

Example: Self intersection of a curve



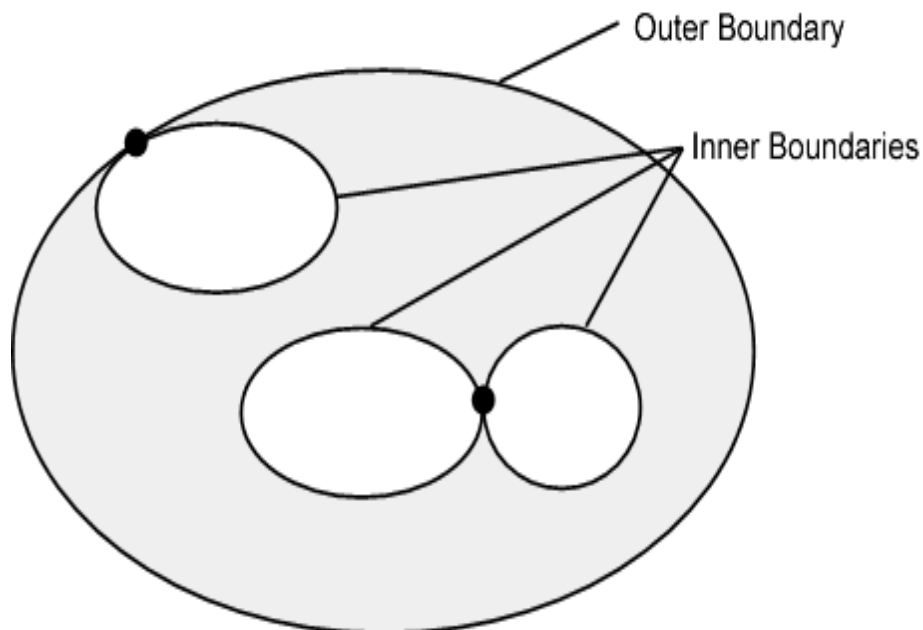


Figure 13 - Area Holes

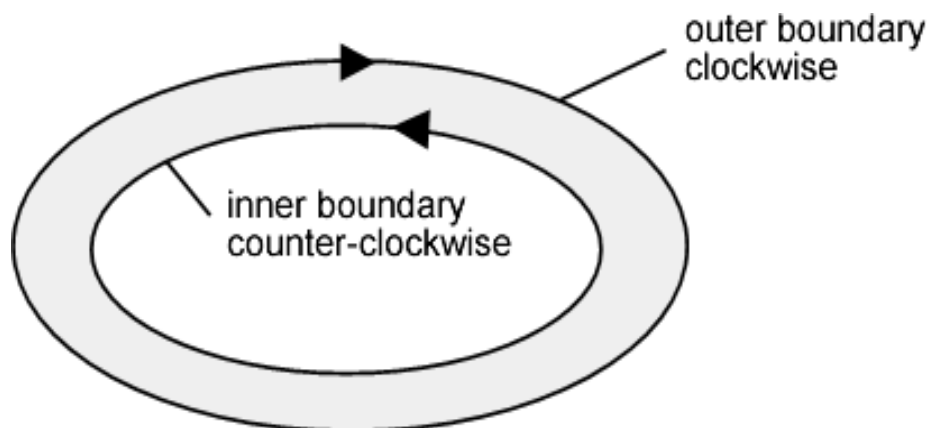


Figure 14 - Boundary Direction

4.8.2 Masking

In certain circumstances, the symbolisation of an edge may need to be suppressed. This is done using the Masked Spatial Type [MASK] field of the Feature Type record. The Mask Update Instruction [MUIN] must be set to {1} and Referenced Record name [RRNM] and Referenced Record identifier [RRID] fields must be populated with the values of the referenced spatial record. The Mask Indicator [MIND] must be set to either {1} or {2} (see Annex B – clause B1.5.13)

Masked lines (MASK subfield of FSPT field set to {1}) and cell boundary lines (edges encoded with [USAG] = {3}) must not be drawn."

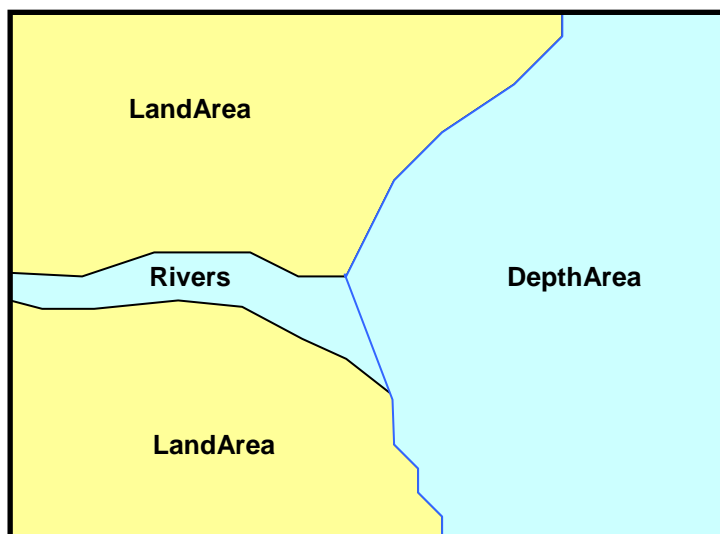


Figure 15 - Example without Masking

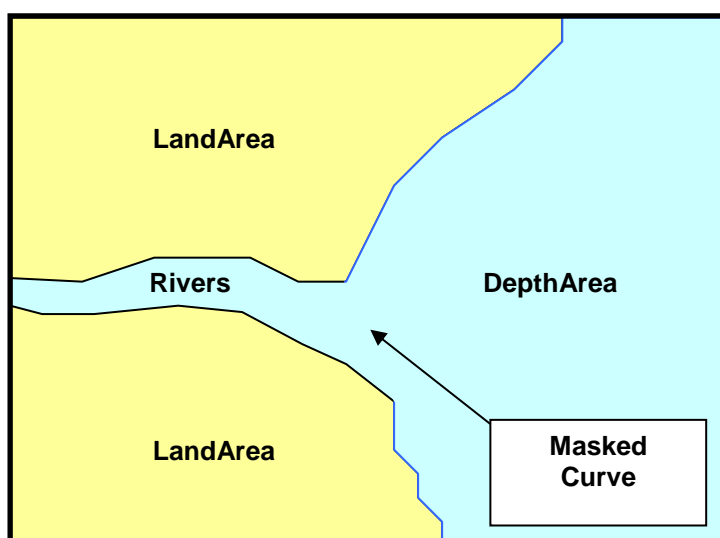


Figure 16 - Example of masked edge between Rivers and Depth Area features, where the River should be masked. In this example MIND is set to {2} – suppress portrayal

5 Coordinate Reference Systems (CRS)

5.1 Introduction

When describing geographic information it is common practice to separate the horizontal and vertical part of a position. This leads to 2D Coordinate Reference Systems for the horizontal positions and 1D Coordinate Reference Systems for the vertical positions. To describe 3D coordinates those Coordinate Reference Systems must be combined to produce a compound Coordinate Reference System. An

ENC data set must define at least one compound CRS. An ENC compound CRS is composed of 2D geodetic CRS (WGS84) and a vertical 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.

5.3 Vertical CRS for Soundings

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

In S-101 depths are represented by positive values down and negative values for intertidal soundings (drying heights).

Although all coordinates in a data set must refer to the same CRS different Vertical Datums can be used for the height or depth component of a coordinate tuple. Therefore the VDAT field can be repeated. For each Vertical Datum a unique identifier is defined. Those identifiers will be used in the 3D - coordinate fields to indicate which Vertical Datum is used. The encoding of the Coordinate Reference System record will be demonstrated with two examples. The first example specifies a compound CRS. The first component is a 2D Geographic CRS (WGS84) and the second component is a Vertical CRS for depth using the Vertical Datum: Mean Sea Level.

```

CSID: RCNM{15}!RCID{1}!NCRC{2}!
CRSH: CRIX{1}!CRST{1}!CSTY{1}!CRNM'WGS
      84'!CRSI'4326'!CRSS{2}!SCRI!
CRSH: CRIX{2}!CRST{5}!CSTY{3}!CRNM'Mean Sea Level Depth'!
      CRSI!CRSS{255}SCRI!
CSAX: AXTY{12}!AXUM{4}!
VDAT: DTNM'Mean Sea Level'!DTID'VERDAT3'!DTSR{2}!SCRI!

```

The second example encodes a projected CRS by defining the details

```

CSID: RCNM{15}!RCID{1}!NCRS{1}!
CRSH: CRIX{1}!CRST{4}!CSTY{2}!CRNM'WGS84/UTM
      32N'!CRSI!CRSS{255}SCRI!
CSAX: AXTY{4}!AXUM{4}!AXTY{5}!AXUM{4}!
PROJ: PROM{2}!PRP1{0}!PRP2{9}!PRP3{0.9996}!PRP4{0}!PRP5{0}!
      FEAS{500000}!FNOR{0}!
GDAT: DTNM'World Geodetic System 1984'!ELNM'WGS 84'!ESMA{6378137}!
      ESPT{2}!ESPM{298.257223563}!CMNM'Greenwich'!CMGL{0}!

```

6 Data Quality

6.1 Introduction

Data Quality is considered to be meta information and for S-101 it is divided into two parts. The first part is overall data quality for the product and the second is data quality of the bathymetric, non-bathymetric and survey information within the product.

6.1.1 Data Compliance and Integrity

For S-101, the data must be validated using S-58 Recommended ENC Validation Checks for the S-101 product specification. Overall data quality for an S-101 ENC should cover the following: completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy, and anything specifically required for the product being specified.

6.1.2 Bathymetric Data Quality

Bathymetric data quality comprises the following:

- completeness of data (e.g. seafloor coverage).
- currency of data (e.g. temporal degradation);
- uncertainty of data;
- source of data;

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

The meta feature for Bathymetric data quality is: **QualityOfBathymetricData**,

6.1.3 Non Bathymetric Data Quality

The meta feature **QualityOfNonbathymetricData** allows for data quality to be expressed for non bathymetric items.

6.1.4 Survey Data Quality

Quality of the surveys that originated these items can be further expressed in **QualityOfSurvey**. **QualityOfSurvey** can apply to bathymetry (e.g. underwater rock), non-bathymetry (e.g. navigational aids) and a combination of these (e.g. lidar survey).

7 Data Capture and Classification

7.1 Introduction

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 in Annex A.

S-101 datasets must conform to all mandatory elements of the ENC DCEG where the word 'must' is used.

8 Maintenance

8.1 Introduction

This clause describes the maintenance process for datasets, source, production process and how feature and portrayal catalogues are to be managed within an S-100 ECDIS.

8.2 Maintenance and Update Frequency

Datasets are maintained as needed and must include mechanisms for ENC updating designed to meet the needs of the mariner regarding safety of navigation.

8.3 Data Source

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

8.4 Production Process

Data Producers should follow their established production processes for maintaining and updating datasets. Data is produced against the DCEG, checked against S-58 and encapsulated in ISO/IEC 8211.

Only datasets that conform to the mandatory requirements outlined in S-101 will be considered an ENC.

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 ECDIS must be able to manage datasets and their catalogues that are created on different versions of the S-101 product specification.

See the Implementation Guidance Annex for specific rules.

9 Portrayal

9.1 Introduction

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

- Ensuring a 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.
- Ensuring the display is clear and unambiguous,
- Ensuring that there is no uncertainty over the meaning of colours and symbols on the display,
- Establishing an accepted pattern for ECDIS presentation that becomes familiar to mariners and so can be recognized instantly without confusion.
- Utilizing the S-100 portrayal model to ensure interoperability.

S-101 portrayal is covered by the portrayal model as defined in S-100 ed 2.0.0. This model reflects how the portrayal catalogue is defined for use in systems. The portrayal catalogue defines symbology and the portrayal rules for each feature attribute combination contained in the feature catalogue.

9.2 Portrayal Catalogue

Item Name	Description	M/O	Card	type
portrayalLibraryCitation	Bibliographic reference to the portrayal library	O	0..1	CI_Citation (ISO 19115)

The S-101 Portrayal Catalogue will be available in an XML document which conforms to the S-100 XML Portrayal Catalogue Schema.

9.2.1 The Portrayal Process

The system has Feature data within its internal database that needs to be portrayed. The System Portrayal Engine transforms the Feature data into drawing instructions. Drawing instructions include such things as references to symbol definitions, priority and filtering information. The drawing instructions are further processed by the rendering engine to produce the final display. In this process, feature data needs to be exposed to the XSLT processor as XML content. The XSLT processor applies the best matching template or portrayal function to each feature. The portrayal function uses the defined logic to transform the input feature content along with related context information into drawing instructions which are output as XML.

9.2.2 The Colour Coding Scheme

The portrayal catalogue uses a colour scheme, which classifies colours by their usage. Each colour usage is represented by a five letter colour token. Each colour token corresponds to a colour definition given in CIE coordinates in one of a set of colour tables for different bridge lighting conditions. Each colour table is referred to as a “pallet” such as “Day-Bright”, “Dusk” and “Night”.

Symbols, fill styles and line styles refer to the colour tables by using the standardized colour tokens as part of the symbol definition.

9.2.3 Symbols, Fill Styles and Line Styles

Symbols, area fill patterns and line styles are part of the portrayal catalogue. The following clauses provide a short description of these elements.

9.2.3.1 Symbols

The portrayal catalogue provides two sets of symbols, referred to as “simplified” and “traditional”. The symbols for point objects are generally based on the traditional paper chart symbols and, in addition a set of more compact, but more visible, 'simplified' buoy and beacon symbols are provided for use under difficult viewing conditions.

9.2.3.2 Area Fills

The portrayal catalogue offers various ways to fill areas. They can be filled with an opaque colour; with a colour shown with some transparency; or with a pattern of symbols (fill pattern) or with a centred symbol. Fill patterns and centred symbols are introduced as a solution for the symbolization of areas in special situations. A fill pattern showing arrows does not have a certain position on the chart like the paper chart arrow-symbol. It shows up as long as any part of the traffic separation lane can be seen on the screen. A centred symbol moves to the centre of the part of the area that remains in the display window.

The portrayal catalogue provides two options for area boundaries, referred to as “plain” and “symbolised”. Centered symbols must be used with symbolized boundaries to symbolize the case when the entire display window lies within an area.

9.2.3.3 Line Styles

The portrayal catalogue uses two types of line styles: simple line styles and complex line styles. Simple line styles are solid, dashed or dotted lines with varying colour and thickness. Complex line styles are composed of repeating line patterns.

9.2.4 Text

S-101 uses two types of text instruction:

- Text relative to a point

- Text that will be drawn along a linear geometry.

9.2.5 Display Priorities

Display priorities control the order in which the output of the portrayal functions is processed by the rendering engine. Priorities with smaller numerical values will be processed first.

The display priority must be of a value between '0' and '9', where '9' identifies the highest priority. The display priority applies irrespective of whether a feature is a point, curve or surface. If the display priority is equal among features, curve features have to be drawn on top of surface features whereas point features have to be drawn on top of both. If the display priority is still equal among features of the same type of geometry (curve, surface or point) the given sequence in the data structure of the SENC, or some other neutral criterion, shall be used for an arbitrary decision as to which object is drawn on top. Text shall be drawn last (except for own ship etc.), in priority 8.

The following table gives an indication of how priorities are allocated. Within each group priorities are adjusted to meet specific cases:

Data Groupings	Display Priorities
no data filled area pattern	priority 0
S-57 group 1 filled areas	priority 1
superimposed areas	priority 2, 3
restricted area	priority 5
traffic areas	priority 6
land features	priority 4, 5
water features	priority 3, 4, 5, 6
coastline features	priority 5, 6, 7
routeing lines	priority 5, 6, 7
symbols for lines and areas	priority 4, 5, 6
hazards (bridge, safety contour)	priority 8
Mariners VRM & EBL	priority 9
own ship	priority 9

9.2.6 Viewing Groups

The viewing group controls the content of the display. It provides an on/off switch in the portrayal catalogue for any drawing instruction assigned to the corresponding viewing group.

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 (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 Data Set Structure Information field under [CMFX] and [CMFY] (see Annex B – clause B1.6.3).

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

EXAMPLE A longitude = 42.0000 is converted into $X = \text{longitude} * \text{CMFX} = 42.0000 * 10000000 = 420000000$.

10.1.2 Encoding of Depths

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

10.1.3 Numeric Attribute Encoding

Floating point or integer attribute values must not be padded by non-significant zeroes.

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). A BOM (byte order mark) must not be used

10.1.5 Mandatory Attribute Values

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

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

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

10.1.6 Missing Attribute Values

In a base data set, 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 data set, 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 unknown value if it was present in the original data set,
- that an unknown value is to be inserted if the attribute was not present in the original data set.

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.

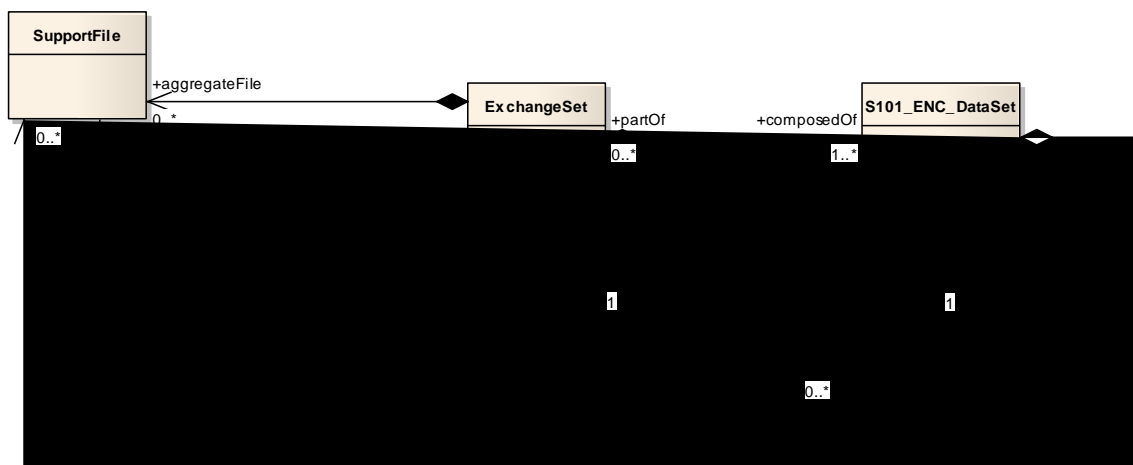


Figure 17 - Exchange Set Structure

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.

Units of Delivery:	Exchange Set
Transfer Size:	Unlimited
Medium Name:	Digital data delivery

Other Delivery Information:

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

Support files are supplementary information which are linked to the features by the following fields within the dataset.

- textualDescription
- graphicalRepresentation

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 (i.e 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:

Mandatory Elements

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

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

Optional Elements

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

S-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:

- Update: Changing some information in an existing data set. The encoding structure for an update is located in Annex B1.6
- re-issue of a dataset : including all the updates applied to the original data set up to the date of the reissue. A re-issue does not contain any new information additional to that previously issued by updates. The encoding structure is located in Annex B1.5
- New dataset and new edition of a dataset: Including new information which has not been previously distributed by updates. Each new edition of a data set must have the same name as the data set 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 B1.5
- Cancellation: The dataset is cancelled and is deleted from the ECDIS. The encoding structure for a cancellation file is located in Annex B1.7

11.3.2 Dataset file naming

CCXXXXXXXXX.EEE

The main part forms an identifier where:

- CC - the first two characters identify the issuing agency.
- the third to tenth characters are optional and may be used in any way by the producer to provide the unique file name. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).
- .EEE – new editions and re-issues use 000, updates start at 001 and increment until a limit of 999.
- The minimum number of characters in a dataset name is three and the maximum number is ten.

Each re-issue or new edition of a dataset must have the same name as the base dataset which it replaces.

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 ECDIS 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 data set is initially created, 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 data set and a new edition. The first update dataset file associated with this new data set must have update number 1. The update number must be increased by one for each consecutive update, until a new edition is released.
Re-issue number	A re-issue of a data set must have the update number of the last update applied to the dataset, and use the same extension as the base dataset.
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 data set, an update dataset file is created for which the edition number must be set to 0. This message is only used to cancel a base dataset file. Where a dataset is cancelled and its name is reused at a later date, the issue date must be greater than the issue date of the cancelled dataset. When the dataset is cancelled it must be removed from the system.

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

11.4 Support Files

Data set 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. (Extensible mark-up language (XML) supports UTF-8 character encoding). (TXT), (XML), (HTM)

Picture files must be in TIFF 6.0 specification (TIFF)

.EEE – support file extension

File Types	Extensions	Comment
Text	TXT	
	HTM	HTML files must only include inline or embedded Cascading Style Sheet (CSS) information and must not embed Javascript or other dynamic content e.g. DHTML, Flash etc.
	XML	XML documents must only be included in accordance with guidance provided within the Data Classification and Encoding Guide. 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 (i.e. new, replacement and deletion).

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

CCXXXXXXXXX.EEE

The main part forms an identifier where:

- the first two characters identify the issuing agency.
- the third to tenth characters can be used in any way by the producer to provide the unique file name. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore).
- .EEE – 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. Support files carrying the "deletion" flag may be removed from the ECDIS. When a feature pointing to a text, picture or application file is deleted or updated so that it no longer references the file, the ECDIS software must check to see whether any other feature referenced the same file, before that file is deleted.

Support files should be stored in a separate folder within the exchange set.

11.5 Exchange Catalogue

The exchange catalogue acts as the table of contents for the exchange set. The catalogue file of the exchange set must be named CATALOG.101. No other file in the exchange set may be named CATALOG. The contents of the exchange catalogue are described in Clause 12.

11.6 Data integrity and encryption

11.6.1 ENC data integrity measures

Where there is a high impact on the integrity of data as a result of data corruption, such as to ENC data, there is a need for a mechanism within the ENC data itself to ensure it has not changed during transmission/delivery. The mechanism chosen for this assurance is a Digital Signature as defined by IHO S-63 edition 2.0 Part(C). File integrity checks are based on the Digital Signature Algorithm (DSA) as defined in the Federal Information Processing Standard FIPS 186-4.

S-101 discovery metadata includes a mandatory field for each included dataset file's digital signature (both data and auxiliary files are included) called "digitalSignature". This contains a base64 encoding of the hexadecimal numbers comprising the digital signature itself. The content of these fields are defined, along with the algorithms for their calculation, in S-63 ed2.0 Part (C). This also defines how chains of signatures may be defined. The digital signature uniquely authenticates the dataset content against the individual producer's public key issued and authenticated by the IHO. The combination of the digital signature, the dataset file and the producer's identity allows the end user to be assured of the origin of the ENC data.

11.6.2 Producer Identity and Authentication

In order to produce a digital signature a producing agency must first have a certified identity as described in S-63 ed2.0 part (C). This describes how to define a public/private keypair specific to the producer and how a data producer or distributor is able to have their identity (as embodied in the public / private keypair) certified by the IHO acting as the data protection scheme administrator.

11.6.3 Digital Signatures and metadata

In addition to the metadata included for each dataset file, its digital signature, an exchange set must also provide a public key for every data producer included within the dataset. The public key is termed “public” because its existence is not kept confidential. Each producer’s public key is included in a “publicKeys” field within the exchange set. These keys are referred to by the digital signature.

Authentication is done in two stages, (1) verifying that the public key information included in the exchange set validates correctly against the IHO’s root level certificate and (2) Verifying that the exchange set ENC data has not changed and the file based digital signatures are valid against the producer’s public key. The IHO’s root certificate (certifying the IHOs identity) should be held externally on the implementing system and is not part of the dataset metadata.

11.6.4 ENC data encryption

If data encryption is required then it must be provided only by the mechanisms provided in IHO S-63 edition 2.0 Part(A) – it is not mandatory. If it is used then the entire dataset file is encrypted using the Blowfish algorithm (as defined in S-63 edition 2.0) and is included in its encrypted form. IHO S-63 also allows dataset files to be compressed using the zip algorithm prior to encryption. This is dealt with in IHO S-63 as well (Part (A)).

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.

This clause defines 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.

Figures 14 to 16 outline the overall concept of an S-101 exchange set for the interchange of geospatial data and its relevant metadata. Figure 1 depicts the realization of the ISO 19139 classes which form the foundation of the exchange set. The overall structure of S-101 metadata for exchange sets is modelled in Figure 15. More detailed information about the various classes is shown in Figure 16 and a textual description in the tables at clause 12.3.

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, e.g. decrypt, decompress, load etc. Other catalogues can be included in the exchange set in support of the datasets such as feature, portrayal, coordinate reference systems, code lists etc. The attribute “purpose” of the support file metadata provides a mechanism to update support files more easily.

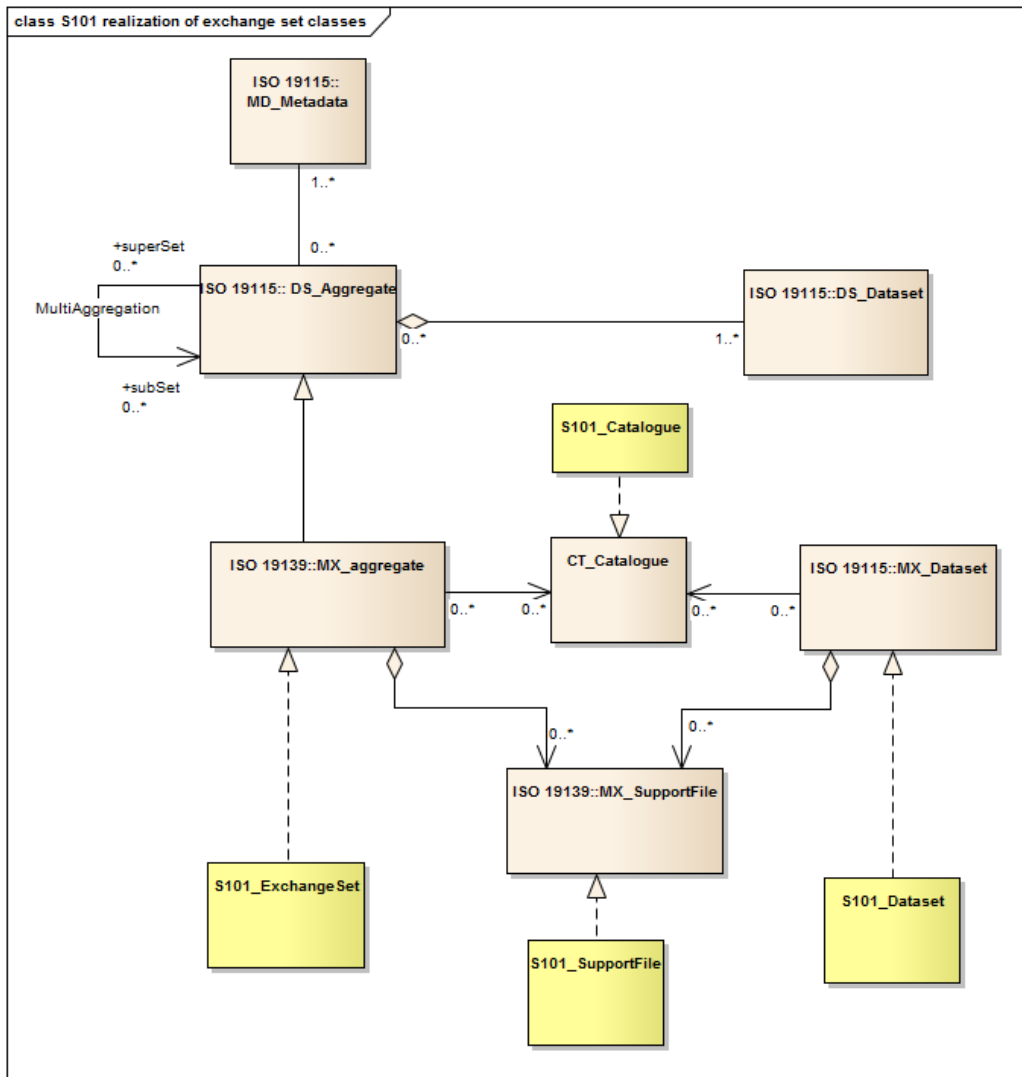


Figure 18 Realization of the Exchange Set Classes

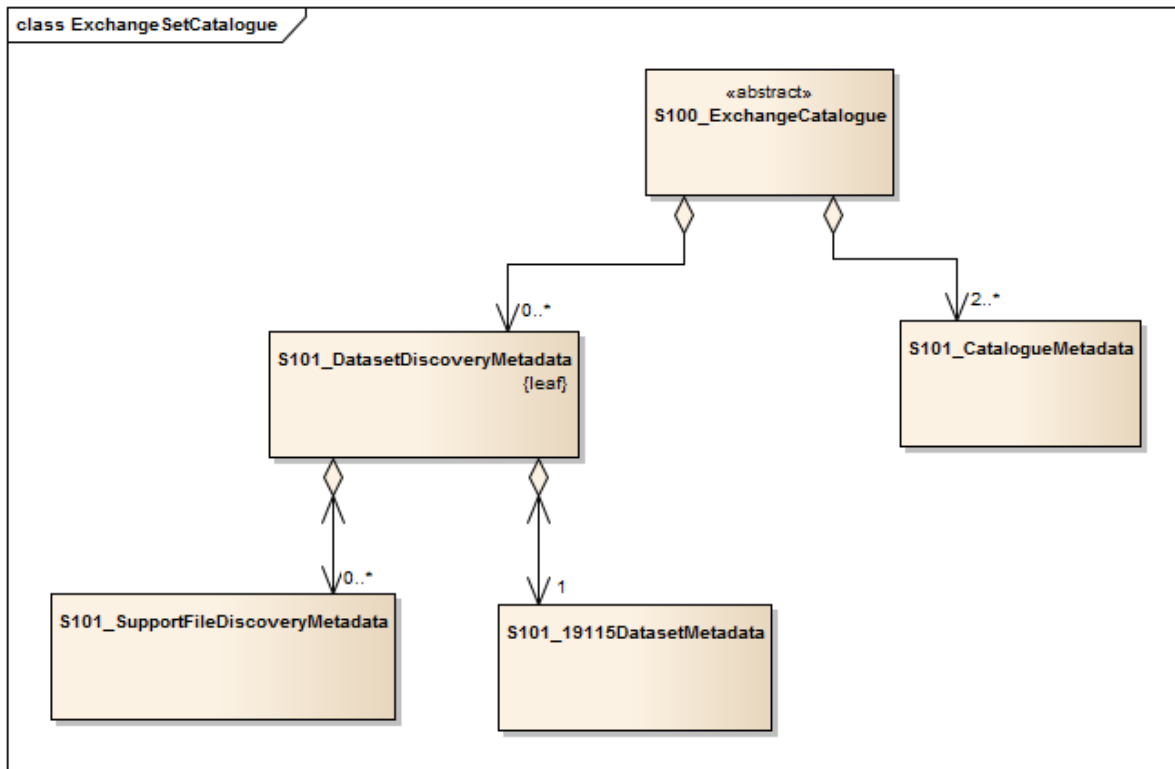


Figure 19 – S-101 ExchangeSet Catalogue

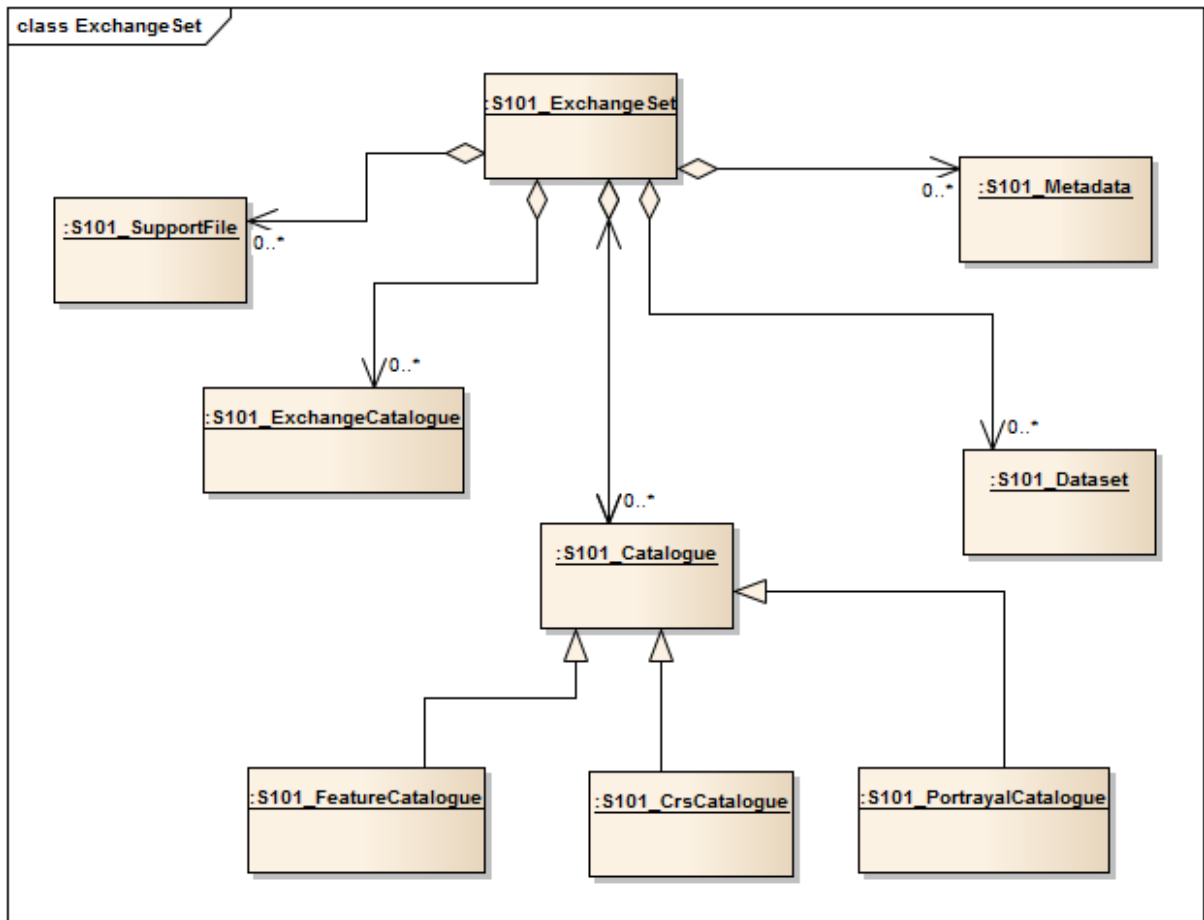


Figure 20 - S-101 Exchange Set

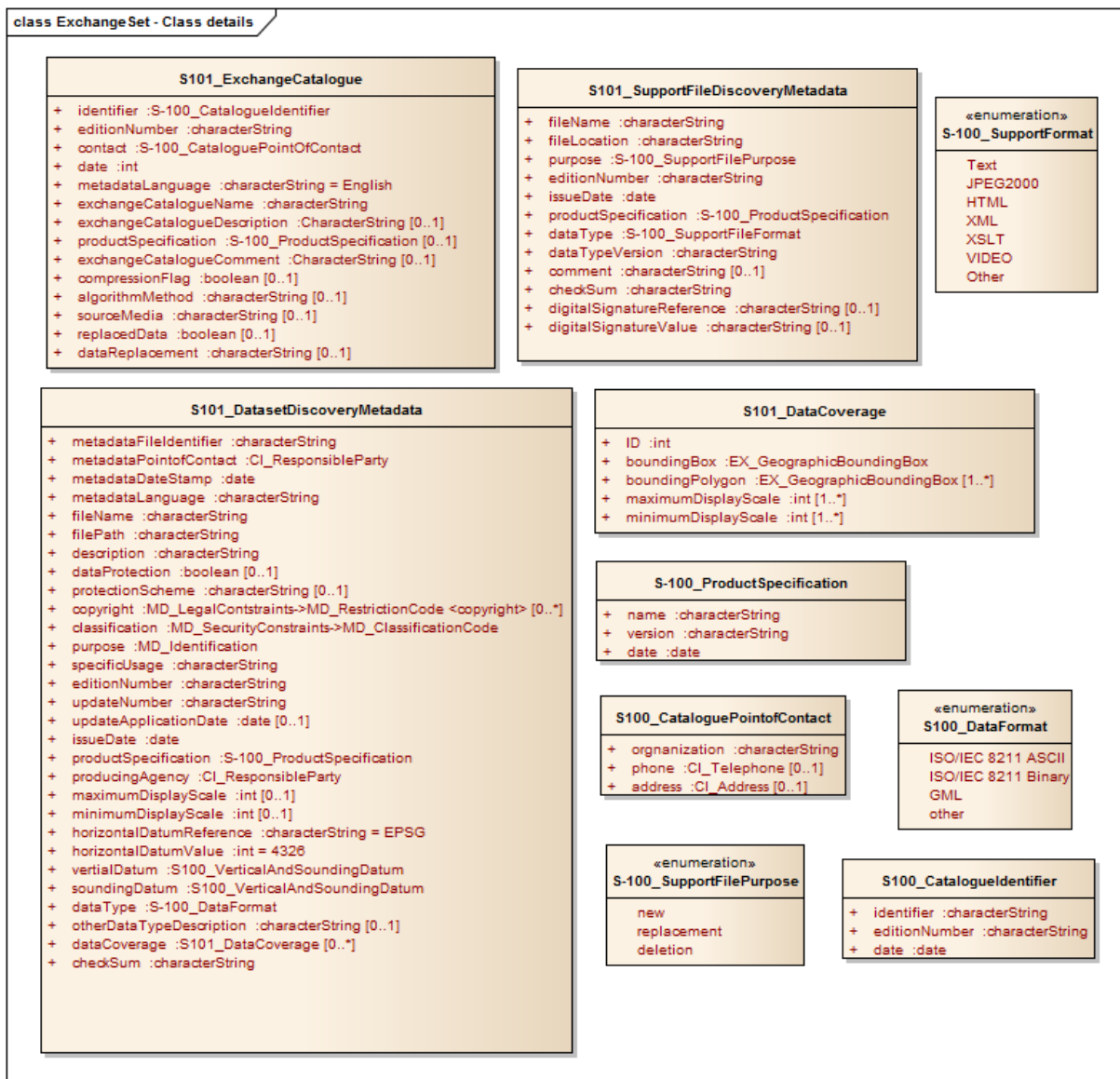


Figure 21 S-101 Exchange Set - Class Details

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.

12.1.1 Dataset Metadata

Name	Multiplicity	Value	Type	Remarks
S101_DataSetDiscoveryMetadata	-		-	-
metadataFileIdentifier	1		CharacterString	The file name must be unique. Each file name must have a MD suffix added to the S-101 file name. Dataset: GB45678.000 Metadata: MD_GB45678_000.xml Update 1: GB45678.001 Metadata: MD_GB45678_001.xml
metadataPointOfContact	1		CI_ResponsibleParty	
metadataDateStamp	1		Date	
metadataLanguage	1	English	CharacterString	All data sets conforming to S-101 PS must use English language
fileName	1		CharacterString	Dataset file name
filePath	1		CharacterString	Path to the dataset file, relative to the root directory of the exchange set. The location of the dataset file after the exchange set is unpacked into directory <EXCH_ROOT> will be: <EXCH_ROOT>/<filePath>/<fileName>
description	1		CharacterString	Short description of the area covered by dataset harbour or port name, between two named locations etc. NATIONAL LANGUAGE enabled
dataProtection	1		Boolean	e.g. Encrypted or Unencrypted

Name	Multiplicity	Value	Type	Remarks
protectionScheme	0..1		CharacterString	e.g. S-63
digitalSignature	1			
copyright	0..*		MD_LegalConstraints ->MD_RestrictionCode <copyright> (ISO 19115)	
classification	1	{1} to {5}	Class MD_SecurityConstraints>MD_ClassificationCode (codelist)	1. unclassified 2. restricted 3. confidential 4. secret 5. top secret
purpose	1	{1} to {5}	CharacterString MD_Identification>purpose (character string)	1. New Dataset 2. New Edition 3. Update 4. Re-issue 5. Cancellation
specificUsage	1	{1} to {3}	CharacterString MD_USAGE>specificUsage (character string) MD_USAGE>userContactInfo (CI_ResponsibleParty)	1. Port Entry – A dataset containing data required: For navigating the approaches to ports for navigating within ports, harbours, bays, rivers and canals, for anchorages as an aid to berthing or any combination of the above. 2. Transit – A dataset containing data required for : navigating along the coastline either inshore or offshore navigating oceans, approaching coasts

Name	Multiplity	Value	Type	Remarks
				<p>route planning</p> <p>or any combination of the above.</p> <p>3.Overview – A dataset containing data required: for Ocean Crossing route planning</p>
editionNumber	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 re-issue.
updateNumber	1		CharacterString	Update number 0 is assigned to a new data set.
updateApplicationDate	0..1		Date	this date is only used for the base dataset files (i.e. new data sets, re-issue and newedition), not update dataset files. All updates dated on or before this date must have been applied by the producer
issueDate	1		Date	Date on which the data was made available by the data producer.
productSpecification	1	S-101 version X.X.X	S100_ ProductSpecification	This must be encoded as S-101.X.X.X – with the X representing the version number
producingAgency	1		CI_ResponsibleParty	Agency responsible for producing the data.
maximumDisplayScale	1	{1} to {15}	Integer	1: 1,000 2: 2,000 3: 3,000 4: 4,000 5: 8,000 6: 12,000 7: 22,000 8: 45,000 9: 90,000 10: 180,000 11: 350,000 12: 700,000

Name	Multiplity	Value	Type	Remarks
				13: 1,500,000 14: 3,500,000 15: 10,000,000
horizontalDatumReference	1	EPSG	CharacterString	
horizontalDatumValue	1	4326	Integer	WGS84
verticalDatum	1	{1} to {30}	S100_VerticalAndSoundingDatum	1 : Mean low water springs 2 : Mean lower low water springs 3 : Mean sea level 4 : Lowest low water 5 : Mean low water 6 : Lowest low water springs 7 : Approximate mean low water springs 8 : Indian spring low water 9 : Low water springs 10 : Approximate lowest astronomical tide 11 : Nearly lowest low water 12 : Mean lower low water 13 : Low water 14 : Approximate mean low water 15 : Approximate mean lower low water 16 : Mean high water 17 : Mean high water springs 18 : High water 19 : Approximate mean sea level 20 : High water springs 21 : Mean higher high water 22 : Equinoctial spring low water 23 : Lowest astronomical tide 24 : Local datum 25 : International Great Lakes Datum 1985 26 : Mean water level 27 : Lower low water large tide 28 : Higher high water large tide 29 : Nearly highest high water 30 : Highest astronomical tide (HAT)
soundingDatum	1	{1} to {30}	S100_VerticalAndSoundingDatum	1 : Mean low water springs 2 : Mean lower low water springs 3 : Mean sea level 4 : Lowest low water 5 : Mean low water 6 : Lowest low water springs 7 : Approximate mean low water springs

Name	Multiplicity	Value	Type	Remarks
				8 : Indian spring low water 9 : Low water springs 10 : Approximate lowest astronomical tide 11 : Nearly lowest low water 12 : Mean lower low water 13 : Low water 14 : Approximate mean low water 15 : Approximate mean lower low water 16 : Mean high water 17 : Mean high water springs 18 : High water 19 : Approximate mean sea level 20 : High water springs 21 : Mean higher high water 22 : Equinoctial spring low water 23 : Lowest astronomical tide 24 : Local datum 25 : International Great Lakes Datum 1985 26 : Mean water level 27 : Lower low water large tide 28 : Higher high water large tide 29 : Nearly highest high water 30 : Highest astronomical tide (HAT)
dataType	1	ISO 8211 BINARY	S100_DataFormat	
otherDataTypeDescription	0..1		CharacterString	
dataCoverage	0..*		S101_DataCoverage	Provides information about data coverages within the dataset

12.1.1.1 S101_DataCoverage

Name	Multiplicity	Value	Type	Remarks
S101_DataCoverage	-	-	-	-
ID	1		Integer	Uniquely identifies the coverage
boundingBox	1		EX_GeographicBoundingBox	
boundingPolygon	1..*		EX_BoundingPolygon	
maximumDisplayScale	1	{1} to {15}	Integer	1: 1,000 2: 2,000 3: 3,000 4: 4,000 5: 8,000 6: 12,000

				7: 22,000 8: 45,000 9: 90,000 10: 180,000 11: 350,000 12: 700,000 13: 1,500,000 14: 3,500,000 15: 10,000,000
minimumDisplayScale	1	{1} to {15}	Integer	1: 1,000 2: 2,000 3: 3,000 4: 4,000 5: 8,000 6: 12,000 7: 22,000 8: 45,000 9: 90,000 10: 180,000 11: 350,000 12: 700,000 13: 1,500,000 14: 3,500,000 15: 10,000,000

12.1.2 Support File Metadata

Name	Multiplicity	Value	Type	Remarks
S101_SupportFileDiscoveryMetadata	-		-	-
fileName	1		CharacterString	
fileLocation	1		CharacterString	Full location from the exchange set root directory
purpose	1	{1} to {3}	class S100_SupportFilePurpose	New – A file which is new Replacement – A file which replaces an existing file Deletion – deletes an existing file
editionNumber	1		CharacterString	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.

Name	Multiplicity	Value	Type	Remarks
issueDate	1		Date	Date on which the data was made available by the data producer.
productSpecification	1		S100_ProductSpecification	Version of S-101
dataType	1	{1} to {4}	class S100_SupportFileFormat	TXT = Text files XML = Text files HTM = Text files TIFF = Picture files
dataTypeVersion	1		CharacterString	The version number of the dataType
Comment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
dataProtection	1		Boolean	e.g. Encrypted or Unencrypted
digitalSignature	0..1		CharacterString	

12.1.3 Exchange Catalogue File Metadata

The catalogue file is defined in XML schema language. The Exchange catalogue inherits the dataset discovery metadata and support file discovery metadata.

Name	Multiplicity	Value	Type	Remarks
S101_ExchangeCatalogue	-			An exchange catalogue contains the discovery metadata about the exchange datasets and support files

Name	Multiplicity	Value	Type	Remarks
identifier	1		CharacterString S100_CatalogueIdentifier	Uniquely identifies this exchange catalogue
editionNumber	1		CharacterString	The edition number of this exchange catalogue
contact	1		S100_CataloguePointofContact CI_ResponsibleParty	
date	1		Date	Creation date of the exchange catalogue
metadataLanguage	1	English	CharacterString	All data sets conforming to S-101 PS must use English language
exchangeCatalogueName	1	CATALOG.101	CharacterString	Catalogue filename
exchangeCatalogueDescription	1		CharacterString	Description of what the exchange catalogue contains NATIONAL LANGUAGE enabled
productSpecification	1			S-101 Version Number
exchangeCatalogueComment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
publicKeys	1..*			
sourceMedia	1			
replacedData	1			If a data file is cancelled is it replaced by another data file
dataReplacement	0..1			Dataset name

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.

Annex A - Data Classification and Encoding Guide

ANNEX B - NORMATIVE

Data Product format (encoding)

B1 Introduction

S-101 uses the S-100 8211 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.

B1.1 Data set files

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

Data set file

- Data set general information record
- Data set structure information field structure
- Data set Coordinate Reference System record structure

Information records

- Information

Vector records

- Point
- Multi point
- Curve
- Composite Curve
- Surface

Feature records

- Meta features
- Geo features
- Aggregated features
- Theme features

This order of records will enable the import software to check that the child record exists each time the parent record references it (i.e. it will already have read the child record so it will know if it exists or not).

B1.2 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.

B1.3 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.

B1.4 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. The “comment” column contains general comments and an indication of whether the subfield is ASCII or binary coded.

When encoding new base data sets the record update instruction (RUI) is always set to insert. When encoding updates it can be set to insert, modify or delete.

B1.5 Base dataset structure

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

Base dataset file

```

|
|--<1>- Data Set General Information record
|
|   |--<1>-DSID (13\\*1): Data Set Identification field
|   |
|   |--<1>-DSSI (13): Data Set Structure Information field
|   |
|   |--<0..*>-ATTR (*5): Attribute field (Metadata)
|
|--<1>--Data Set Coordinate Reference System record
|
|   |--<1>-CSID (3): Coordinate Reference System Record Identifier field
|   |
|   |--<1..*>-CRSH (7): Coordinate Reference System Header field
|   |
|   |   |--<0..1>-CSAX (*2): Coordinate System Axes field
|   |   |
|   |   |--<0..1>-VDAT (4): Vertical Datum field
|
|--<0..*>--Information record
|
|   |--<1>-IRID (5): Information Type Record Identifier field
|   |
|   |   |--<0..*>- ATTR (*5): Attribute field
|   |   |
|   |   |--<0..*>- INAS (5\\*5): Information Association field
|
|--<0..*>-- Point record
|
|   |--<1>-PRID (4): Point Record Identifier field
|   |
|   |   |--<0..*>-INAS (5\\*5): Information Association field
|   |   |
|   |   |   alternate coordinate representations
|   |   |
|   |   *-<1>-C2IT (2): 2-D Integer Coordinate Tuple field
|   |   |
|   |   *-<1>-C3IT (4): 3-D Integer Coordinate Tuple field
|
|--<0..*>-- Multi Point record
|
|   |--<1>-MRID (4): Multi Point Record Identifier field
|

```

```

|         |-<0..*>-INAS (5\\*5): Information Association field
|         |
|         | alternate coordinate representations
|         |
|         |*-<0..*>-C2IL (*2): 2-D Integer Coordinate List field
|         |
|         |*-<0..*>-C3IL (1\\*3): 3-D Integer Coordinate List field
|
|--<0..*>-- Curve record
|   |
|   |--<1>-CRID (4): Curve Record Identifier field
|   |
|   |   |-<0..*>-INAS (5\\*5): Information Association field
|   |   |
|   |   |--<1>-PTAS (*3): Point Association field
|   |   |
|   |   |--<1>-SEGH (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 Feature 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..*>-THAS (*3): Theme Association field
|   |   |
|   |   |-<0..*>-MASK (*4): Masked Spatial Type field

```

B1.5.1 Field Content

B1.5.2 Data Set 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	"1.1"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-101.1.0"	A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED	"1.0"	A()	Edition of the product specification
Application profile	PROF	"1"	A()	"1" – EN Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLGL	"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 ??
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

B1.5.3 Data Set Structure Information field - DSSI

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

Number of Feature Type records	NOFR		b14	Number of feature records in the data set
--------------------------------	------	--	-----	---

B1.5.4 Attribute field - ATTR

Subfield name	Label	Value	Format	Comment
Attribute label/code	*ATLB		b12	A valid attribute code
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.

B1.5.5 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
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Information Association code	IASS		b12	A valid code for the information association
Role code	ROLE		b12	A valid code for the role
Information Association Update Instruction	IUIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute label/code	*ATLB		b12	A valid attribute code
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.

B1.5.6 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 >{1} - Compound CRS

B1.5.7 Coordinate Reference System Header field - CRSH

Subfield name	Label	Value	Format	Comment
CRS index	CRIX		b11	1 - for the horizontal CRS >1 - for the vertical CRS's
CRS Type	CRST	{1} or {5}	b11	{1} - 2D Geographic {5} - Vertical

Coordinate System Type	CSTY	{1} or {3}	b11	{1} - Ellipsoidal CS {3} - Vertical CS
CRS Name	CRNM	"WGS84" for horizontal CRS "Depth - *" for vertical CRS where * is the name of the vertical datum	A()	
CRS Identifier	CRSI	"4326" – for horizontal CRS "omitted for vertical CRS	A()	
CRS Source	CRSS	{3} for horizontal CRS {255} for vertical CRS	b11	{3} - EPSG {255} - Not Applicable
CRS Source Information	SCRI	omitted	A()	

B1.5.8 Coordinate System Axes field - CSAX

This field is only used for vertical CRS.

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

B1.5.9 Vertical Datum field – VDAT

This field is only used for vertical CRS.

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

B1.5.10 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 $2^{32}-2$
Feature code	OBJC		b12	A valid information type code from the FC
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B1.5.11 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

B1.5.12 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

B1.5.13 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)

B1.5.14 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

B1.5.15 2-D Integer Coordinate List field structure – C2IL

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

B1.5.16 3-D Integer Coordinate List field structure – C3IL

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

B1.5.17 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

B1.5.18 Point Association field - PTAS

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

B1.5.19 Segment Header field - SEGH

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

B1.5.20 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

B1.5.21 Curve Component field - CUCO

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

B1.5.22 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

B1.5.23 Ring Association field - RIAS

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

B1.5.24 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
Feature code	OBJC		b12	A valid feature type code from the FC
Record version	RVER		b12	RVER contains the serial number of the record edition
Record update instruction	RUIN	{1}	b11	{1} - Insert

B1.5.25 Feature Feature 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

B1.5.26 Spatial Association field - SPAS

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

B1.5.27 Feature Association field – FASC

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Feature Association Code	ASCD		b12	A valid code for the feature association
Role Code	RLCD		b12	A valid code for the role
Feature Association Update Instruction	FAUI	{1}	b11	{1} - Insert
Attribute label/code	*ATLB		b12	A valid attribute code
Attribute index	ATIX		b12	Index (position) of the attribute in the sequence of attributes with the same code and the same parent (starting with 1).
Parent index	PAIX		b12	Index (position) of the parent complex attribute within this FASC field (starting with 1). If the attribute has no parent (top level attribute) the value is 0.
Attribute Instruction	ATIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute value	ATVL		A()	A string containing a valid value for the domain of the attribute specified by the subfields above.

B1.5.28 Theme Association field - THAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Theme Association Update Instruction	TAUI	{1}	b11	{1} - Insert

B1.5.29 Masked Spatial Type field - MASK

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

B1.6 Update dataset structure

Update dataset file

```

|
|--<1>- Data Set General Information record
|
|   |--<1>-DSID (13\\*1): Data Set Identification field
|   |
|   |--<1>-DSSI (13): Data Set Structure Information field
|   |
|   |--<0..*>-ATTR (*5): Attribute field (Metadata)
|
|--<0..*>--Information record
|
|   |--<1>-IRID (5): Information Type Record Identifier field
|   |
|   |--<0..*>- ATTR (*5): Attribute field
|   |
|   |--<0..*>- INAS (5\\*5): Information Association field
|
|--<0..*>-- Point record
|
|   |--<1>-PRID (4): Point Record Identifier field
|   |
|   |--<0..*>-INAS (5\\*5): Information Association field
|   |
|   | alternate coordinate representations
|   |
|   *-<1>-C2IT (2): 2-D Integer Coordinate Tuple field
|   |
|   *-<1>-C3IT (4): 3-D Integer Coordinate Tuple field
|
|--<0..*>-- Multi Point record
|
|   |--<1>-MRID (4): Multi Point Record Identifier field
|   |
|   |--<0..*>-INAS (5\\*5): Information Association field
|   |
|   |--<0..1>-COCC (3): Coordinate Control field
|   |
|   | alternate coordinate representations
|   |
|   *-<0..*>-C2IL (*2): 2-D Integer Coordinate List field
|   |
|   *-<0..*>-C3IL (1\\*3): 3-D Integer Coordinate List field
|

```

```

|--<0..*>-- Curve record
|
|   |--<1>-CRID (4): Curve Record Identifier field
|   |
|   |   |--<0..*>-INAS (5\\*5): Information Association field
|   |   |
|   |   |--<1>-PTAS (*3): Point Association field
|   |   |
|   |   |--<0..1>-SECC (3): Segment Control field
|   |   |
|   |   |--<1>-SEGH (1): Segment Header field
|   |   |
|   |   |   |--<0..1>-COCC (3): Coordinate Control Field
|   |   |   |
|   |   |   |--<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
|   |   |
|   |   |--<1..*>-RIAS (*5): Ring Association Field
|   |
|
|--<0..*>-- Feature Type record
|
|   |--<1>-FRID (5): Feature Type Record Identifier field
|   |
|   |   |--<1>-FOID (3): Feature Feature 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..*>-THAS (*3): Theme Association field
|   |   |
|   |   |--<0..*>-MASK (*4): Masked Spatial Type field

```

B1.6.1 Field Content

B1.6.2 Data Set 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	"1.1"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-101.1.0"	A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED	"1.0"	A()	Edition of the product specification
Application profile	PROF	"2"	A()	"2" – ER Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLGL	"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 ??
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

B1.6.3 Data Set Structure Information field - DSSI

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

B1.6.4 Attribute field - ATTR

Subfield name	Label	Value	Format	Comment
Attribute label/code	*ATLB		b12	A valid attribute code
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.

B1.6.5 Information Association field

Field Tag: INAS	Field Name: Information Association
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Subfield name	Label	Value	Format	Subfield content and specification
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Information Association	IASS		b12	A valid code for the information association
Role	ROLE		b12	A valid code for the role
Information Association Update Instruction	IUIN		b11	{1} - Insert {2} - Delete {3} - Modify
Attribute label/code	*ATLB		b12	A valid attribute code
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.

B1.6.6 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
Feature code	OBJC		b12	A valid information type code from the FC
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

B1.6.7 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

B1.6.8 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

B1.6.9 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)

B1.6.10 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

B1.6.11 2-D Integer Coordinate List field structure – C2IL

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

B1.6.12 3-D Integer Coordinate List field structure – C3IL

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

B1.6.13 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
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B1.6.14 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	RUII	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B1.6.15 Point Association field - PTAS

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

B1.6.16 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

B1.6.17 Segment Header field - SEGH

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

B1.6.18 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	RUII	{1},{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify

B1.6.19 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

B1.6.20 Curve Component field - CUCO

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

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

Ring Association field - RIAS

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

B1.6.21 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
Feature code	OBJC		b12	A valid feature type code from the FC
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

B1.6.22 Feature Feature 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

B1.6.23 Spatial Association field - SPAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM	{1} to {5}	b11	Record name of the referenced record {1} - 110 {2} - 115 {3} - 120 {4} - 125 {5} - 130
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

B1.6.24 Feature Association field – FASC

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Association Code	FASS		b12	A valid code for the association
Role Code	ROLE		b12	A valid code for the role
Feature Association Update Instruction	FAUI	{1} ,{2} or {3}	b11	{1} - Insert {2} - Delete {3} - Modify
Attribute label/code	*ATLB		b12	A valid attribute code
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.

B1.6.25 Theme Association field - THAS

Subfield name	Label	Value	Format	Comment
Referenced Record name	*RRNM		b11	Record name of the referenced record
Referenced Record identifier	RRID		b14	Record identifier of the referenced record
Theme Association Update Instruction	TAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

B1.6.26 Masked Spatial Type field - MASK

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

B1.7 Dataset cancellation structure

Dataset cancellation file

```

|
|--<1>- Data Set General Information record
|
|--<1>-DSID (13\\*1): Data Set Identification field

```

B1.7.1 Field Content

B1.7.2 Data Set 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	"1.1"	A()	Edition of the encoding specification
Product identifier	PRSP	"INT.IHO.S-101.1.0"	A()	Unique identifier for the data product as specified in the product specification
Product edition	PRED	"1.0"	A()	Edition of the product specification
Application profile	PROF	"2"	A()	"2" – ER Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLGL	"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

Annex C – Normative Implementation Guidance

C1 Overview

C1.1 Introduction

The purpose of this Normative Annex is to provide additional implementation guidance for S-101. While the product specification provides the main rules, this annex will provide additional information and use cases for implementation.

This annex is set up to be a cross-reference to S-101, therefore its clause numbering will refer back to the originating guidance in S-101.

EXAMPLE: If there is additional guidance in for dataset loading and unloading (4.6.1) it will have a clause in this annex that corresponds with the main product specification (C4.6.1).

C4 Data Content and structure

C4.1 Feature Catalogue

The S-101 feature catalogue is in XML and describes the various feature types, information types, attributes, attribute values, associations, roles and their bindings that are used for ENC datasets. The feature catalogue will be tied to a version of the S-101 product specification and may be obtained from the IHO website or may be delivered with S-101 datasets as part of the exchange catalogue.

C8 Maintenance

C8.1 Feature and Portrayal Catalogue Management

C9 Portrayal

C9.1 Introduction

This section contains additional guidance for the implementation of portrayal within an S-101 enabled ECDIS. While much of the existing S-52 presentation library is now housed in the portrayal catalogue, this clause contains subsets of S-52 – *Specifications for Chart Content and Display Aspects of ECDIS*, which are still required for ECDIS to conform to the IMO Performance Specification and IEC 61174.

C9.1.1 Concept and limitations of ECDIS

The concept of ECDIS is outlined in the introduction section of the IMO Performance Standards. The following contains additional ECDIS related considerations.

- ECDIS, used together with official data, [is] accepted as complying with the up-to-date charts carriage requirements for nautical publications required by regulation V/19 of the 1974 SOLAS Convention amended in 2009. It may be noted that electronic chart systems not meeting these ECDIS specifications of IHO and IMO, or ECDIS using non-official data, are known as ECS (Electronic Chart Systems).
- Chart information may be used in conjunction with a radar overlay on ECDIS. Integration of tracked radar targets provided for collision avoidance radar (ARPA) and targets tracked by AIS (Automatic Identification System) into the ECDIS display is

another option. In addition, in certain cases the chart information may be displayed in conjunction with other S-100 based product specifications such as surface currents, ocean weather or ice information.

- The colours and symbols defined in the S-101 portrayal catalogue are conceptually based on the familiar symbology of conventional paper charts. However, due to the special conditions of the ECDIS chart display as a computer generated image, the ECDIS presentation of ENC data does not match the appearance of a conventional paper chart closely. Instead, there are considerable differences in symbology in shape, colour and size, and in the placement of text in particular. The display of the ENC data and the conventional paper chart do not necessarily have to be identical in their appearance.
- ECDIS combines chart and navigational positioning information. It should be noted that modern navigation systems (e.g. differential GPS) may offer a more accurate positioning than was available to position some of the surveys from which the digital chart data ENC was derived.
- The display categories specified in the IMO Performance Standards and the IHO priorities of the various types of chart information (alarms, updates, mariners and non-HO chart data, etc.) are applied to every feature by the display category and draw priority assignments that are contained within the S-101 portrayal catalogue.
- Depth information should only be displayed as it has been provided in the ENC and not adjusted by tidal height. If the ECDIS has integrated the use of a S-10X tidal product specification, it may display the adjusted tide as an italicized offset to the sounding in the ENC.

C9.1.2 Function and Use of S-101 portrayal

The IHO has produced S-101, in order to ensure that hydrographic data supplied by its Member States' HO is used in a manner that will enhance the safety and efficiency of navigation by satisfying the requirements set out in the IMO Performance Standards for ECDIS.

Users of these Specifications should also refer to publications of the International Electrotechnical Commission (IEC) when dealing with equipment design and tests.

C9.1.3 Type Approval - Minor Deviations to the S-101 Portrayal Catalogue

It is acknowledged that the manufacturers of navigational equipment and software are in constant contact with ECDIS users. To allow for fast response to suggestions for improvement to the chart display, the IHO S-101 Product Specification for ECDIS is designed to provide a framework and guideline for chart symbolization from which the ECDIS manufacturer may derive a customized presentation. The following criteria shall serve as a guide for judging whether any symbolization on an ECDIS which is visibly different from the symbolization provided by the IHO S-101 Portrayal Catalogue and as demonstrated by the IHO Test Data Set print-outs is still compliant. The symbolization used:

- should be the same in general shape and size as the IHO version;
- should be clear and sharp so that there is no uncertainty over meaning;

- should be close enough to the IHO version to avoid ambiguity in meaning between that model and any other model of ECDIS;
- should use only the colours as specified in S-101;
- should comply with the priority of prominence on the display in proportion to importance to safety of navigation which is built into the portrayal catalogue, and
- should avoid any increase in clutter.

Any symbolization which does not meet these criteria is not compliant.

The type-approval authority is strongly encouraged to contact the IHO in any case of uncertainty over differences in symbolization, ideally attaching graphics to illustrate the situation. The IHO will give the reason for the particular symbolization on the Test Data Plots, and will comment on any perceived advantages or disadvantages of the manufacturer's version, with reasons.

Manufacturers, type-approval authorities, and above all mariners, are always encouraged to contact the IHO over any improvements, criticisms, questions or comments that they **may** have about the ECDIS display, in order that the specifications can be kept effective and up to date.

C9.2 Display Considerations

C9.2.1 The diversity and flexibility of ECDIS

The challenge presented by the versatility of ECDIS is illustrated below:

The diversity of information may include:

- physical chart information, (e.g. coastline, depth contours, buoys),
- traffic routing; specified areas; cautions; etc.,
- supplementary HO information from light list, etc.,
- mariner's notes; additional local chart information; manufacturer's information,
- chartwork such as planned route; electronic bearing lines and range rings; etc.,
- own ship's position and velocity vector; ship's head and rate of turn; past track,
- fix accuracy, or position check from secondary positioning system,
- possibly, shiphandling options, based on ship's characteristics, alphanumeric navigation information (ship's latitude, longitude, heading, course, etc.),
- information from radar and other sensors,
- information from AIS,
- navigational indications and alarms generated by ECDIS,
- possibly, telemetered information from shore authorities, (traffic, real-time tides etc.),
- possibly, ice information,
- reminders, (e.g. time to contact pilot station),
- possibly, messages from other displays (e.g. alarm on engine room display).

The flexibility of portrayal may include:

- displaying/removing various types of chart and non-chart information,
- selecting standard chart display or a thinned out display, and full or simplified symbols,
- using cursor interrogation for further detail,
- overlaying/removing radar video or radar target information (in order to: confirm ship's positioning; aid radar interpretation; show the entire navigation situation on one screen),
- overlaying/removing various other sensor information, or information telemetered from shore,
- changing the scale or orientation of the display,
- selecting true motion or relative motion,

- changing screen layout with windowed displays, text information in the margins, etc.,
- possibility of pull-down menus and other operator interaction devices being alongside the operational navigation display and so interacting with it,
- giving navigation and chart warnings such as "too close approach to safety contour"; "about to enter prohibited area"; "overscale display"; "more detailed (larger scale) data available"; etc.,
- possibly, a diagrammatic representation of a computer evaluation of grounding danger,
- possibly, a diagrammatic representation of the immediate vicinity of the ship to aid in close quarters manoeuvring,
- other future developments. (Further presentation requirements and techniques appropriate to ECDIS are likely to be developed in future).

C9.2.2 Display of non-chart information

C9.2.2.1 Distinguishing between chart data and additional data

IMO PS section 1.5 states that ECDIS should enable the mariner to execute the chartwork at present performed on the paper chart and section 3.3 states that the SENC may contain information from other sources than ENC's. This specification requires that ECDIS distinguish between chart data and additional data from users (mariners) and manufacturers. The following colour and symbol usage for mariners and manufacturers data is designed to implement this while ensuring the display remains clear and uncluttered.

The XXXX describes "Mariner's Navigational Features" for route planning and route monitoring chartwork, and for adding mariner's and manufacturer's information to the SENC. The descriptions are in the same format as chart features, in order to avoid the ECDIS having to deal with two differently coded types of data. The colours, symbols, categories and display procedures that apply to all these features are included in the S-101 Portrayal Catalogue, along with the procedures for chart features.

Mariners may alter the IMO categories for Mariner's Features (but not for chart features). Note, however, that IMO PS 11.4.1 requires that own ship and selected planned route should always appear, and should therefore remain in Display Base.

Note that Mariner's Features should be kept independent of chart data in the SENC, and that mariners' information does not need to be split into cells.

In referring to Mariner's Features it is important to distinguish between:

- "Add/Enter", "Revise" or "Delete" mariner's or manufacturer's information; this refers to the contents of the SENC, and:
- "Display" or "Remove" the information; this refers to the ECDIS display.

C9.2.2.2 Mariner's Information on the route monitoring display

In addition to the ability to enter manual chart corrections and to carry out route planning and route monitoring chartwork, the mariner should be provided with the capability of adding at least the following symbols, lines and areas to the SENC, and should be able to revise or delete them:

- the caution "(!)" or information "[i]" symbol, used to call up a note on the text display by cursor picking,
- simple lines and areas with or without colour fill, set up for cursor picking to give an explanatory note in the text display,
- any of the chart symbols from the portrayal catalogue,
- text notes.

Non-ENC chart information added by the mariner should be in normal chart colours as specified in the portrayal catalogue

Other information added by the mariner should be distinguished by the colour orange (colour token NINFO) except for colour fill, which should use transparent yellow (colour token ADINF).

Mariner's information should not overwrite ENC information.

C9.2.2.3 Manufacturer's Information on the route monitoring display

If the manufacturer should add non-chart information to the SENC, they should use the following symbols, lines and areas:

- the circled “!” caution symbol SY(CHINFO11), or boxed “i” information symbol SY(CHINFO10), used to call up a note on the alphanumeric display by cursor picking,
- simple lines, or areas without colour fill, set up for cursor picking to give an explanatory note in the alphanumeric display (colour fill should not be used).
- Non-chart information entered by the manufacturer should be distinguished by the colour yellow (colour token ADINF). It should not overwrite HO ENC information.

If the manufacturer should add non-HO (non- ENC) chart information to the SENC it should be symbolised in the same way as HO chart information and distinguished from HO chart information as described for the various cases below:

- Limited non-HO data is added to existing HO data to augment the chart information. Each feature should be marked by the special identifiers.
- An area of non-HO data is located in waters for which HO chart data exists; it is superimposed on the HO data. In some cases the non-HO data may be more appropriate for the intended purpose, for example it may be more detailed.
- In this situation it is at the mariner's discretion whether to use the HO or the non-HO data.
- If the mariner selects the non-HO data, the boundary of this data should be identified on the ECDIS display by the line LC(NONHODAT) and the warning “Unofficial data displayed; refer to official RNC or paper chart” should be displayed.

An area of non-HO data is located wholly outside the area covered by HO data (although it may share a boundary with the HO data) but is shown on the same display as HO data.

The entire display contains nothing but non-HO data. The warning “No official data available; refer to official RNC or paper chart.” should be displayed. In this case, special identifiers need not be used.”

The mariner should be able to remove all manufacturer's information if the need should arise.

C9.2.2.4 Displaying pick reports

The following information should be shown on demand on the same screen as the chart display or on an additional graphic or text display:

- Positional data and time;
- legend;
- feature description and associated attributes (result of "cursor query") in human readable language, including the meaning given in the portrayal catalogue for any symbol selected by cursor-pick; textual information from ENC, e.g. cell name, compilation date, date of issue;
- record of ENC-updates;

- ECDIS Chart 1;
- [colour differentiation diagram];
- [black adjust symbol for contrast adjustment];
- list of categories which are removed from Standard Display;
- Edition number of S-101 Product Specification in use.

C9.2.2.5 Units

The units listed below should be indicated in the display legend:

Position: latitude and longitude in degrees, minutes and decimal minutes.

Depth: metres and decimetres.

Height: metres.

Distance: nautical miles and decimal miles, or metres.

Speed: knots and decimal knots.

C9.2.2.6 Legend

A standard legend of general information relating to the area displayed, applicable to the position selected by the mariner, should be shown on a graphic or text display. This legend should contain at minimum:

- (1) units for depth
- (2) units for height
- (3) scale of display; in addition overscale indication where appropriate
- (4) data quality indicator
- (5) sounding/vertical datum
- (6) horizontal datum
- (7) the value of the safety depth if used
- (8) the value of the safety contour selected by the mariner, as well as the value of the safety contour displayed (which may be different from that selected by the mariner)
- (9) magnetic variation
- (10) date and number of last update affecting the chart cells currently in use
- (11) edition number and date of issue of the ENC
- (12) chart projection

C9.2.3 Priority of information

C9.2.3.1 Priority layers

The IMO PS divides SENC information into three categories that determine what data is to be on the display: Display Base (always present on the display); Standard Display (the default display); and Other Information (displayed on demand). (IMO PS section 3 and Appendix 2).

There are 10 priority layers for the drawing sequence of the data on the display:

- (1) ECDIS visual alarms/indications (e.g. caution, overscale)
- (2) HO-data: points/lines and areas + official updates
- (3) NtMs, manual input and Radio Navigational Warnings
- (4) HO-caution (ENC cautions)
- (5) HO-colour-fill area data
- (6) HO's on demand data
- (7) Radar information
- (8) Mariners data: points/lines and areas
- (9) Manufacturer's data: points/lines and areas
- (10) Mariners colour-fill area data

This list is not intended to indicate a drawing sequence, but to specify that the information content of category n+1 must not obscure the information content of category n, or any higher category (i.e. n-1 etc.).

Category (7) should have a radar off switch to facilitate its removal.

The portrayal catalogue assigns a category, and a display priority (drawing sequence), to every feature (feature-attribute combination) in the ENC.

C9.2.3.2 Radar priority

The priority of HO chart data over radar is carried out by the single action "remove radar" control (IMO PS 7.2). When present, the radar data is always written over the eight opaque area fills. Chart curve and point features should normally be written over the radar image, with some exceptions, as described in the "over-radar" field of the portrayal catalogue. But in order to meet the requirements of IMO PS 11.4.14 to adjust the ship's position, the ECDIS may incorporate the capability of changing the radar priority of the portrayal catalogue. Operation of this feature should be clearly indicated.

C9.2.4 Display categories

C9.2.4.1 IMO categories

The IMO "Standard Display" is a list of features that the mariner may either add further features to, or remove features (except Display Base) from, in deciding what is to be displayed. As soon as any feature on this list is removed from the display, or any feature not on this list is added to the display, the display no longer shows the IMO "Standard Display".

The IMO "Display Base" is that part of the Standard Display that should never be removed. It is a list of basic features which the IMO consider to be required at all times, in all geographic areas and under all

circumstances. The IMO do not intend the Display Base to be sufficient for safe navigation on its own; therefore it should not be a display option to "Show Display Base" without any additions.

The IMO category "Other Information" contains every feature in the SENC which is not classed as "Standard Display".

The mariner should be able to remove information selectively from "Standard Display", except that they cannot remove any feature of the "Display Base". And they should be able to add selectively to the Standard Display any items of the "Other" category.

The portrayal catalogue assigns the IMO category in detail to every feature in the SENC, including Mariner's Navigational Features. The mariner may override the category for mariner's features, but not for chart features.

C9.2.4.2 Selecting features for the route monitoring display

Section 5.5 of the IMO Performance Standard requires that "It should be easy to add or remove information from the ECDIS display". For example, the mariner might want to retain "caution areas" from the Standard Display (see Table 4 of this document) but remove the remaining thirteen areas, including such as protected areas (e.g. "game preserve"). Another example is that they might want to add soundings from "Other", but omit submarine cables (which cause serious clutter at certain ocean terminals).

As an aid to adding and removing information from the display, the portrayal catalogue also assigns every feature in the SENC to a viewing set, and these sets are arranged in groups of ten which are related to the lettered groups of INT 1 for the paper chart, a classification which is familiar to the mariner.

The manufacturer is responsible for organising SENC features, viewing sets and viewing groups for display in such a way that the mariner has reasonable flexibility in selecting what he sees without the selection process becoming too complex. Note that it is not necessary to provide access to each feature, viewing set or even viewing group individually.

Note that combined groups which include features from different IMO categories should not be linked permanently, since doing so would, in effect, drag additional features into the Display Base or Standard Display. For example, if a combined group includes soundings (which are "Other") and lights (which are "Standard Display"), this link should not cause soundings to be shown with the Standard Display on first switching on the ECDIS.

C9.2.4.3 Selecting text for the route monitoring display

The ECDIS manufacturer **should** provide the mariner with control over the selection and display of text on the route monitoring display.

Text **should** not appear automatically whenever the feature it is associated with appears on the display. It **should** always be possible to remove text independently of the feature. The IMO Display Category for text is "other".

C9.2.4.3 Linkages in selecting mariner's options

Because vessels vary widely in their requirements and their operational procedures, linkages between options which reduce the flexibility of the ECDIS must be avoided.

C9.2.5 Displaying ECDIS updates

This section deals with how updates should be displayed. It is keyed to the relevant sections of the IMO PS.

IMO PS 4.5	Automatic and semi-automatic updates: these should be displayed in the same manner as ENC information, using standard colours and symbols.
IMO PS 4.6	Manual updates: these should be displayed in standard colours and symbols and distinguished as described in the portrayal catalogue
IMO PS 4.8	The mariner should be able to display updates for review as follows:

C9.2.5.1 Automatic updates

The manufacturer must provide a means of distinguishing automatic updates. The S-101 feature catalogue provides encoders with an **UpdateInformation** feature that is used to represent a change to the information shown.

EXAMPLE: The ENC update contains updates to various features that adjoined the feature that was actually updated. In this case, the producer will use an **UpdateInformation** feature to indicate the actual feature that was affected and a brief description of the changes.

C9.2.5.1 Manual Updates

The manual updates should be distinguishable.

C9.3 SYMBOLISING AREAS, LINES & POINTS AND FOR TEXT

C9.3.1 Mariner's options in symbols and linestyles

The portrayal catalogue therefore provides, as a mariner's option, symbolised area boundary linestyles for use on large scale displays. These make the areas easier to figure out than the plain linestyles recommended for small scale displays, where symbolised lines would cause clutter. Two options are provided within the portrayal catalogue, to display either symbolised or plain area boundary linestyles.

The mariner should be given the option of selecting the buoy symbols and area boundary linestyles that best fit the situation, without linkages. For example, boundary linestyle should be selectable independent of the choice of buoy symbol, and independent of the actual display scale.

C9.3.2 Areas

Areas can be identified both by symbolising the area itself and by symbolising its boundary.

The portrayal catalogue provides large transparent symbols for centred symbols and small symbols for pattern coverage:

- Centred symbols are used where it is important to avoid clutter, particularly in traffic lanes. The symbol must be placed within the area.
- For a pattern of small symbols, the spacing between the symbols lies within the limits:
 - minimum distance apart: 2 cm.
 - maximum distance apart: 10 cm.
- It would be ideal to space the symbols further apart for a large area and closer together for a smaller area. However reliable symbolising is more important, and a constant fixed-space symbol pattern should be used.
- Pattern symbols need not line up exactly between cells; and they need not stay in the same geographic position on re-draw.
- It should always be possible to identify an area by cursor picking on any point within the area.
- If the ECDIS offers a ship-centred display mode, the manufacturer should avoid overwriting between the ship symbol and a centred symbol for an area which wholly encloses the display (for example the traffic direction arrow (TSSLPT) in a very large traffic lane such as Dover Strait).

C9.3.2.1 Symbolising the area boundary

To help clarify this situation, the portrayal catalogue includes two area rules for areas: (i) the "symbolised area boundaries" rules, using symbolised and "one-sided" versions of the boundary lines of important areas. This is for use at large scale as a mariner-optional alternative to (ii) the "plain area boundaries" rules, which uses simple linestyle area boundaries. This will normally be preferred at smaller scales to avoid clutter.

C9.3.2.2 Symbolised complex linestyles

To identify the area, symbols (or letters acting as symbols) are embedded in the line, e.g.:

anchoring prohibited or restricted - LC(ACHRES 51)

deep water route - LC(DWRUTE 51)

C9.3.2.3 One-sided complex linestyles

To identify the side of the boundary line on which the area lies, restricted areas use the traditional "T" linestyle of the paper chart, e.g.:

entry prohibited or restricted - LC(ENTRES 51).

Other important areas use a boundary linestyle like the cold front on a weather map, e.g.:

waiting area - LC(CTYARE 51)

fairway - LC(NAVARE 51)

C9.3.2.4 Simple linestyles

Dashed lines are generally used for area boundaries. In ECDIS, the dotted line is reserved for the danger line around foul areas, etc.

C9.3.2.5 Colours

The colour magenta is used for important areas, grey for less important areas, e.g.:

traffic areas, caution areas - magenta

harbour limits - grey

C9.3.3 Symbol Specifications

All symbols are specified in the S-101 Portrayal Catalogue and are in the Scalable Vector Graphics (SVG) format.

Some object classes do not have a symbol (e.g. territorial sea). Such "no symbol" objects may be picked up by cursor interrogation of the area.

Should an "unknown object" occur in the SENC which is not adequately defined or for which no symbol exists, its presence should be indicated on the display by a magenta "?" SY(QUESMRK1) with the IMO category "Standard Display".

Some objects are symbolised differently depending on circumstances (for example the symbol for a contour depends on whether it is the safety contour.) The portrayal catalogue includes XSLT code for features whose symbols cannot be supplied by a simple XML.

C9.3.4 Size of lines, symbols and text; fonts

Lines and symbols and text should be large enough that they can be easily interpreted at the operational viewing distance. This will be about 70 cm for route planning, but experience to date indicates that the viewing distance for important features during route monitoring may be several metres.

The minimum sizes for all symbols should be as shown in the portrayal catalogue.

When the display scale is enlarged by zooming in, it should be possible to hold symbol size constant. The same applies to text. Symbol and text size should never be decreased when zooming out.

The text on the ECDIS should be readable from 1 metre.* Sans serif, non-italic fonts should be used. The computer \emptyset should not be used.

C9.3.5 Display Orientation

It should always be possible to display the chart north-up (IMO PS section 8.1), but other orientations are allowed.

Symbols and text should always be drawn screen-up, no matter what the orientation of the screen may be. Symbols which include "rotate" in the symbology instruction (eg light flares) should be rotated with respect to the top of the screen. However symbols that are oriented according to an S-101 attribute such as ORIENT should be oriented with respect to true north.

The north arrow is always required on the display, as part of the IMO Performance Standards Display Base.

C9.3.6 ENC scale; Graphical Index of ENC's by Navigational Purpose; Limit of HO data

C9.3.6.1 ENC scale

The **minimumDisplayScale** and **maximumDisplayScale** of the ENC is the range of scales at which the ENC was designed to be displayed. It may not be the same as the scale of the source data. As required by IMO Performance Standards, section 6.1.1, an overscale indication should be shown whenever the mariner selects a display scale that is larger than **maximumDisplayScale**.

C9.3.6.2 Overscale

Overscale is where the mariner has zoomed larger than the largest **maximumDisplayScale** of the ENC data that is shown in the mariner's viewing window.

C9.3.6.2.1 Overscale Indication

The overscale indication is intended to remind the mariner that the size of chart errors is magnified when they increase the display scale. A 1 mm error at compilation scale of 1/20,000 becomes a 1.3 mm error at a display scale of 1/15,000 and a 2 mm error at 1/10,000.

The overscale factor shall be calculated as [denominator of the compilation scale] / [denominator of the display scale], expressed as, for example "X1.3", or "X2" (using the figures in the example above.)

This shall be indicated on the same screen as the chart display, and treated as display base. Use colour SCLBR.

This overscale indication is required by IMO PS [3] whenever the display scale exceeds the compilation scale.

NOTE If the display is compiled from more than one ENC of the same **maximumDisplayScale**, and if the mariner deliberately chooses to zoom in so that the display scale exceeds the **maximumDisplayScale**, then only the "overscale indication" shall be shown. The "overscale pattern" AP(OVERSC01) shall not be shown

C9.3.6.3 Scale boundary

This shows where the **maximumDisplayScale** of the ENC data available changes. The ECDIS should warn the mariner of upcoming ENC scale change. Only the major changes in **maximumDisplayScale** resulting from the scale jumping more than three **maximumDisplayScales** should be shown.

The "chart scale boundaries", where the **maximumDisplayScale** of the data changes, shall be symbolised on the ECDIS display by a simple linestyle LS(SOLD,1,CHGRD). Alternatively linestyle LC(SCLBDYnn) may be used, with the double line (indicating better resolution) on the side of the larger scale data. The display priority is 3; over-radar; standard display; viewing group 21030.

C9.3.6.4 Overscale area at scale boundary

All the chart data on the display must be shown at the same scale. In order to avoid leaving part of the display blank, the chart display may extend beyond the edge of a relatively large scale ENC to include information from an adjoining smaller scale ENC, which may be from a **maximumDisplayScale**. The smaller scale data will normally be enlarged to match the larger scale ENC, and in this case the "overscale area" symbol should be used to identify any part of the chart display shown outside the range that is between the **maximumDisplayScale** and the **minimumDisplayScale**.

NOTE This symbol applies only to the automatic overscaling performed by the ECDIS in matching ENCs at different **maximumDisplayScales**. It should not be applied to an overscale display deliberately requested by the mariner, which should trigger the overscale indication required by IMO Performance Standard section 6.1.1.

A different overscale situation arises when the ship approaches a scale boundary from a larger to a smaller scale ENC, typically when leaving harbour. In combining data from the large scale and the small scale ENCs to generate a display at the larger scale, the ECDIS will have "grossly enlarged" the small scale data.

In addition to drawing the scale boundaries, the "grossly overscale" part of the display shall be identified with pattern AP(OVERSC01), as illustrated. Its display priority is 3; over-radar; standard display; viewing group 21030.

In this context, "grossly enlarged" and "grossly overscale" shall be taken to mean that the display scale is enlarged/overscale by X2 or more with respect to the **maximumDisplayScale**. For example, at the left edge of Fig 5 the display scale of 1/12,500 is X4 the **maximumDisplayScale** of 1/50,000, and so the overscale pattern is required.

Note that in this situation the pattern AP(OVERSC01) shall only be shown on the area compiled from the smaller scale ENC. If the area from the larger scale ENC is also overscale, this shall be indicated by the "overscale indication". The pattern AP(OVERSC01) shall not be shown on the part of the display taken from the larger scale ENC. For example if the display scale of the situation in the data coverage diagram was 1/3,500 the area of compilation scale 1/12,500 would have an overscale indication of X 3.6 but would have no pattern AP(OVERSC01).

C9.3.6.5 Automatic overscale at a scale boundary

Where ENCs of different **maximumDisplayScale's** overlap, the ECDIS display of the overlap area should show two "chart compilation scale boundaries", at the beginning and end of the overlap. Beyond one boundary the part of the display taken from the smaller scale ENC will often be grossly overscale.

Only the major changes in compilation scale resulting from a change in "navigational purpose" should be shown as scale boundaries on the display. Small changes in compilation scale within a navigational purpose should not be shown.

When the display cannot be completely covered with ENC data for the selected **maximumDisplayScale**, the remaining part of the display should be filled with data from the next smaller **maximumDisplayScale** (if available).

C9.3.6.3 Larger Scale Data Available

As the mariners display window moves begins to cover an ENC that is of a larger **maximumDisplayScale**, the ECDIS must indicate that larger scale data will shortly become available, as required by IMO PS [3].

C9.3.6.4 Graphical Index of ENCs by maximumDisplayScale

Without cursor enquiry of the chart area it will not always be clear what **maximumDisplayScale** applies to a given part of a mixed source display. S-101 requires a graphical index of the **maximumDisplayScale** of the data to clarify the situation. The navigational purpose metadata field in the ENC catalogue file must only be used for folio purposes.

C9.3.6.5 Limit of HO data

The end of HO chart data on this graphical index defines the limit of HO ENC coverage.

Since the HO will not issue a data coverage diagram, the ECDIS shall compile a graphical index of the HO ENC data available, classified by **maximumDisplayScale**, and make it available to the mariner.

The end of HO data need not be identified on the display. The appearance of the "No data" colour (NODTA) and fill pattern AP(NODATA03) will indicate the end of data.

If non-HO data is shown on the ECDIS display, its boundary shall be identified by the linestyle LC(NONHODAT). The display priority is 3; over radar; display base; viewing group 11060. Note that the LC(NONHODAT) is a "one-sided" line and the boundary of the non-HO data must be drawn according to S-101 rules to ensure that the diagonal stroke of the line is on the non-HO data side of the line.

C9.3.6.6 Data from non-HO sources

The non-HO data boundary LC(NONHODAT) serves to separate ENC data from non-HO chart information.

C9.3.6.7 No data areas

The first action of the ECDIS display re-draw should be to cover the entire screen with the NODTA area colour fill and the AP(NODATA03) area pattern. These will remain to identify any area not subsequently covered by chart information as a no data area.

An indication "refer to the official chart" is required if the display includes waters for which no ENC at appropriate scale exists.

If a scale boundary is shown on the display, the information in an overscale area should be identified, and should not be relied on.

A graphical index of the navigational purpose of available data should be shown on demand.

An indication that the mariner must refer to the official chart shall be given whenever line LC(NONHODAT) appears on the display, or whenever the display is comprised of other than ENC data.

C9.3.7 Chart data quality indicator

A bathymetric data quality indicator will cover the entire area of depth data or bathymetry for the ENC.

C9.3.8 Cursor enquiry

It should be possible to call up any of the information associated with an object by cursor enquiry on its symbol. This should extend to areas (restricted area, depth area, etc.) and to "no symbol" areas (territorial seas, etc.) and meta-areas (information about the area such as compilation scale, etc.). The search for area information needs to extend only to the cell boundaries enclosing the position of the cursor.

C9.3.8 Special ECDIS chart symbols to identify unsafe depths

The ECDIS highlights four features that are important for safe navigation. These are the safety contour, depth shades, the safety depth and isolated dangers

C9.3.8.1 Safety Contour

The own-ship safety contour, selected by the mariner from among the contours in the SENC, is double-coded by a thick line and a prominent change in depth shade.

If the safety contour selected by the mariner is not available in the SENC, the ECDIS should default to next deeper contour and inform the mariner. If, when the ship moves onto a new chart, the safety contour previously in use is no longer available, the ECDIS should again select the next deeper contour, and inform the mariner.

If the mariner does not select a safety contour, the value should default to 30 m.

C9.3.8.2 Depth zone shades

Depth zone shades are defined by the safety contour and selected shallow and deep contours and the drying line.

The safety contour defines two depth zone shades and the drying line a third:

deep water:	deeper than the safety contour (colour token DEPDW),
shallow water:	shallower than the safety contour (colour token DEPVS),
intertidal area:	area exposed at low water (colour token DEPIT).

A "depth less than safety contour" pattern is provided in the portrayal catalogue to reinforce the depth shade. It is optional for the manufacturer to provide this feature, but its inclusion is strongly recommended as a safety feature.

The mariner should be given the option of whether to use this pattern, by night or by day (although it is not strictly necessary by day when the shallow water can be clearly identified by the difference in depth shade).

It is recommended that the ECDIS should also allow the mariner the option of selecting a deep contour and a shallow contour from among the contours in the SENC, thus establishing the following five depth zones:

deep water:	deeper than the deep contour (colour token DEPDW),
medium-deep water:	depths between the deep contour and the safety contour (DEPMD),
medium-shallow:	depths between the safety contour and the shallow contour (DEPMS),
very shallow water:	depths between the shallow contour and zero metre contour (DEPVS)
drying foreshore:	intertidal area (DEPIT)

The following depth zones may be used as default values:

deep water:	deeper than 30 m (deep draught vessels)
medium deep:	own-ship safety contour to 30 m
medium shallow:	2 m to the own-ship safety contour
very shallow:	0 to 2 m (defines waters accessible to small craft)
intertidal:	exposed at low water

C9.3.8.3 Safety Depth

The own-ship safety depth is intended as an aid when no appropriate safety contour is available in the SENC. Soundings equal to or less than the safety depth selected by the mariner are made more conspicuous than deeper soundings. A separate set of sounding figures is provided in the portrayal catalogue.

C9.3.8.4 Isolated dangers

Isolated dangers (small shoals, rocks, wrecks, obstructions) of depth less than the safety contour, and also lying within the 'safe' water defined by the safety contour, are highlighted by a special symbol. Because the mariner may sometimes have to navigate in water shallower than a default safety contour, the mariner may also select to show isolated dangers in the 'unsafe' water between the displayed safety contour and the zero metre contour.

C9.3.9 Other ECDIS symbols and their use

C9.3.9.1 Mariners Caution Notes

Point cautions and notes entered by the mariner and the manufacturer are distinguished by the colours orange and yellow respectively.

C9.3.9.2 Unknown object

A magenta "?" marks the position of an object which cannot be identified or for which there is no rule set in the portrayal catalogue.

C9.3.9.3 Change of horizontal (geodetic) datum

The use of non-WGS 84 ENC data does not comply with IHO S-101, and the boundary at which the local geodetic datum changes is not symbolized by the portrayal catalogue.

C9.3.9.4 Scale bar or latitude scale

The IMO PS require an indication of scale and range as part of the Display Base. The display scale decides which should be used:

- for display scales larger than 1/90,000: always display the 1 mile scale bar provided in the portrayal catalogue
- for display scales at 1/90,000 or smaller: always display the 10 mile latitude scale provided in the portrayal catalogue.

The scale bar or latitude scale should always be drawn vertically at the left side of the chart display, just clear of the border of the display.

The mariner should be able to remove any labels on the scales to avoid clutter.

C9.3.9.5 North arrow

The IMO PS requires a north arrow as part of the Display Base. The north arrow should always be shown at the top left corner of the chart display, just clear of the scale bar or latitude scale.

C9.3.9.6 Manual chart correction

Small orange identifiers are used to distinguish hand-entered chart corrections, which are subject to human error, from corrections entered automatically by electronic means. The original chart object should not be removed or altered.

C9.3.9.7 One-sided linestyle

A one-sided linestyle is provided for use on large-scale displays to indicate the side of an area boundary on which the area lies, when only a part of the boundary can be seen on the display.

C9.3.9.8 Special identifiers

Identifiers are provided for low accuracy chart data and for ENC objects which have additional information for cursor picking utilizing the S-101 information type **supplementaryInformation** that is associated to the feature using the information association **additionalInformation**. The latter may cause clutter, and should only be displayed temporarily.

C9.4 Text, Diagrams etc.

C9.4.1 Text as part of the display

Text information should be used on the route monitoring display only when unavoidable, since it has to be written large to be readable and so causes clutter.

The complex attribute **featureName** has a Boolean sub-attribute **displayName**. When the ENC data is encoded with a **displayName** as true then it is intended for that **featureName** to be displayed on the ECDIS. This is intended to declutter much of the text display on an ECDIS. The other alternative **featureNames** must be able to be queried by the pick report.

Soundings are treated by the portrayal catalogue as symbols to ensure they are legible and correctly located.

In addition the following guidance should be used for text:

1. Text is normally coloured black, to give best readability under all light conditions.
2. Text shall only be displayed when the object it applies to is displayed.
3. Text shall always have display priority 8, to ensure it is readable, independent of the object it applies to.
4. The manufacturer shall provide the capability to select "Important Text" and "Other Text", and they may also provide further text groupings if they so wish.

The display of text must be controlled independently of the display of the object it applies to and the Mariner must have full control over the display of text. All text is in the IMO Category "Other Information".

C9.4.2 Text Groupings

Value of Text Group	Text Group Description	S-101 Features and Attributes
00-10	reserved for future assignment by IHO.	
IMPORTANT Text		
10		
11	Vertical Clearance of Fixed Spans	Span fixed, vertical clearance fixed Vertical clearance value
	Vertical Clearance of Open Spans	Span Opening Vertical Clearance Closed Clearance Value Vertical Vertical Clearance open Clearance Value vertical
	Vertical Clearance of Overhead Cable	Cable Overhead Vertical Clearance fixed Clearance Value Vertical Vertical Clearance Safe Clearance Value Vertical
	Vertical Clearance of Overhead Pipeline	Pipeline overhead Vertical Clearance fixed Clearance Value Vertical
	Vertical Clearance of Conveyor	Conveyer Vertical Clearance Fixed Clearance Value Vertical
	Bearing of Navline	Navigation Line Orientation
	Recommended Route	Recommended route centreline
	Deep Water Route Centreline Line	Deepwater route centreline
	Recommended Track	Recommended track
Name and Communications Channel	Radio Call in Point	

	of Radio Calling-In Point	Feature Name Communications Channel
Other Text		
20		
21	Name or Number of Buoys	Buoy xxx Feature Name
	Name or Number of Beacons	Beacon xxx Feature Name
	Name or Number Daymarks	Daymark Feature Name
	Name or Number Light Vessel	Light Vessel Feature Name
	Name or Number Light Float	Light Float Feature name
	Name or Number Offshore Platform	Offshore Platform Feature Name
22	Na (Not Allocated)	
23	Light Description String	
24	Note on chart data (INFORM) or nautical publication (TXTDSC)	Supplementary Information
25	Nature of Seabed	Seabed Area Surface Characteristics Nature of surface
26	Geographic Names	Anchorage Area Feature Name
		Bridge Feature Name
		Builtup Area Feature Name
		Building Single Feature Name
		Dock Area Feature Name
		Fairway Feature Name
		Landarea Feature Name
		Landmark Feature Name
		Land Region Feature Name
		Sea Area Feature Name
		Tideway Feature Name
		Pilot Boarding Place Feature Name
27	Value of Magnetic Variation	Magnetic Variation Value of magnetic variation
	Value of Swept Depth	Swept Area Depth range minimum value
28	Height of Islet Or Land Feature	Landarea Height
29	Berth Number	Berths Feature Name
		Anchor Berth Feature Name
30	Na	

*31	National Language Text	Feature Name Language Name
32-49	Reserved For IHO	
50-69	Mariners' Text, Including Planned Speed Etc.	
70-79	Manufacturer's Text	
80-99	Future Requirements	

C9.4.2 ECDIS Text Group Implementation

To enable the Mariner to make selections regarding the text visible in the chart display the ECDIS shall use the individual text groups collected under text group layer.

For standardization of the ECDIS Human Machine Interface (HMI) and to facilitate generic training of Mariners as a minimum the following text group layers shall be implemented to control the display of text. An ECDIS **may** provide more textual on/off controls than are available in this table, but OEMs shall use the names of text group layer contained in this table.

An example of more detailed selections;

The table has text group layer "Other text". An OEM **may** wish to subdivide this category into "names", "light description" and "other".

Text Layer	Group	Name of Text group layer in the ECDIS	Text groups included
1		Important text	11
2		Other text	20-49, 0-10
2.1		Names	21, 26, 29
2.2		Light description	23
2.3		All other	0-10, 25, 27, 28, 32-49

C9.4.2 Abbreviations

The abbreviations listed below are to be used on the ECDIS display. The meanings of the abbreviations shall be available to the Mariner through the pick report.

C9.4.2.1 'TE' text command abbreviations

The following abbreviations are used with the "TE" command word:

Préfixes	Suffixes	'C' Format Command
bn = beacon (INT1)	kn = knots	% = instruction follows,
by = buoy	(INT1)	%s = text string,
clr = overhead clearance	deg = degrees	%d = integer number,
clr cl = clearance closed		%n.mlf = floating point
clr op = clearance open		number with n
sf clr = safe clearance		characters
No = number (INT1)		(including the deci-
Plt = pilot		mal), m of which
Prod = offshore production (INT1)		come after the deci-
LtV = light vessel		mal point.
Varn = magnetic variation		
ch = communication channel		
NMT = not more than "CLEARING		

BEARING” NLT = not less than “CLEARING BEARING”		
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C9.4.2.2 Nature of seabed abbreviations ('TX')

The following abbreviations for values of **natureOfSurface**:

Attribute ID	Description	ECDIS Abbreviation
1	mud	M
2	clay	Cy
3	silt	Si
4	sand	S
5	stones	St
6	gravel	G
7	pebbles	P
8	cobbles	Cb
9	rock	R
11	lava	R
14	coral	Co
17	shells	Sh
18	boulder	R


To reduce undue clutter in the ECDIS chart display, it is recommended that ECDIS manufacturers use the abbreviations of the NATSUR attribute.

C9.5 XML Display Examples

C9.5.1 Text

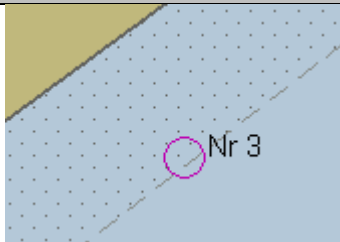
NEED to add XML example for displaying text and then rework the table as a so show what attributes are being called from the model.

Name		Description	ECDIS Display
ECDIS Textual Output	featureName displayName	Charmouth	

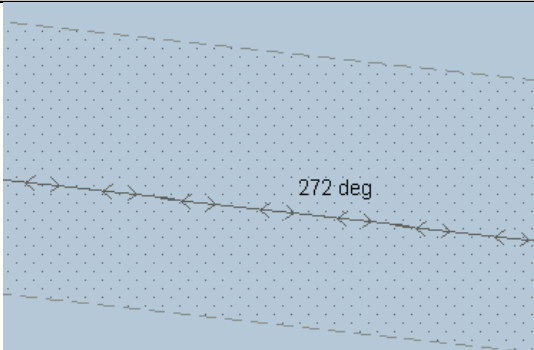
			
--	--	--	--

C9.5.2 Alphanumeric Examples

NEED to add XML example for displaying text and then rework the table as a so show what attributes are being called from the model.


Name		Description	ECDIS Display
ECDIS Textual Output	Nr (string from attribute OBJNAM)		

NEED to add XML example for displaying text and then rework the table as a so show what attributes are being called from the model.

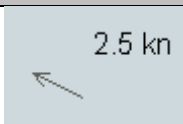
Name		Description	ECDIS Display
ECDIS Textual Output		Floating point number from attribute ORIENT followed by deg	

C9.5.3 Point

NEED to add XML example.

S-101 Symbol	Description	ECDIS Example
BOYCAR01	Simplified symbol - North Cardinal Mark	
LIGHTDEF, 135	LIGHTDEF is a symbol selected by a conditional symbology procedure (LIGHTS06). The command string "SY(LIGHTDEF,135)" selects a default light flare rotated by 135 degrees	

NEED to add XML example.

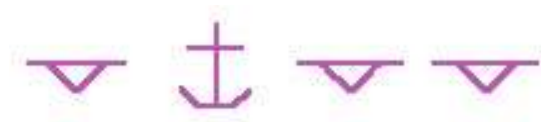
S-101 Symbol	Description	ECDIS Example
EBBSTR01	<p>Tidal stream - flood/ebb object, ebb stream symbol rotated by value from the ORIENT attribute.</p> <p>In the example ORIENT = 297.3</p>	

C9.5.3 Curve

NEED to add XML example


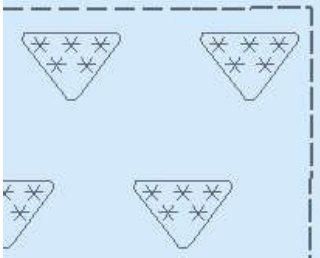
LS(DASH,2,CHMGD). Displays a dashed line in "chart magenta, dominant", 0.6 mm (2 x 0.3 mm) width.

LC(ACHARE51). Displays the complex line-style called ACHARE51 defined for borders of anchorage areas. (see below).



C9.5.3 Surface

NEED to add XML example

S-101	Description	Example
AC(CHBRN)	area filled with opaque colour 'chart brown'	
AP(DQUALA21);LS(DASH,2,CHGRD)	area filled with pattern for 'category of zone of confidence; bordered by a dashed line in 'chart grey , dominant', 0.6 mm width	

C9.6 Specification for Colours

C9.6.1 General

The colours are specified in CIE (Commission Internationale de l'Eclairage) xy chromaticity coordinates and luminance L. The ECDIS colour scheme based on specification of colour tokens and color conversion tolerances.

The Colour Tables are in the portrayal catalogue.

Note that these colour specifications apply to both the operational chart display (for route planning and route monitoring), and also to any text on the same screen as the chart display.

C9.6.2 The colour tables

There are three colour tables, all of which shall be made available to the mariner. They are specified as part of the portrayal catalogue. They are as follows:

DAY	The "Day" table uses a white background as a result of a comparative test outdoors in bright sunlight which showed that a display background of maximum luminance gives the best contrast achievable under near-washout conditions. This conclusion has been confirmed by subsequent sea experience.
DUSK	The "Dusk" colour table is a black background table, which may also be used by day as a mariner's option.
NIGHT	At night the light emitted by the display must be strictly limited to avoid impairing night vision. In case the luminance needs to be further reduced, the "Night" colour table may be augmented by a luminance-reducing neutral density filter which should have 8 times attenuation, designated (logarithmically) "0.9 ND". (This is a manufacturer's option).

C9.6.3 Transparency

Transparent fill can be achieved in two ways:

- with a given percentage of the pixels having the transparent fill
- by mixing the fill and underlay colour by mixing the fill and underlying colour at each pixel to give a continuous transparency change from 0% to 100%. This shall be done in such a way that no appearance of colour or shape change occurs in any SENC feature on the display, at any intermediate transparency value. The underlying SENC information shall remain distinguishable, except when the overlay colour approaches 100%.

C9.7 General Colour Assignment for ECDIS Features

Colour	Comment
black/white	(black by day / white by night) is used for critical navigation features which need highlighting by contrast against their background to give them adequate prominence. Examples are the own-ship symbol, dangerous soundings less than the safety depth, buoys, conspicuous objects on land etc. It is also used for text, which is less clear in any other colour.
white/black	(white by day / black by night) as a background area shade is used for deep, safe, water.
magenta	is used to highlight critically important features such as isolated dangers, traffic routes, anchorages; and for restricted areas, submarine cables, gas pipelines etc. It is also used for aids to navigation and services such as daymarks, racons, and pilot stations.
grey	is used for many features which are black on the paper chart. It is used with thick lines for critical physical objects such as bridges and overhead cables, and with thin lines for important but less critical physical features such as non-dangerous soundings, sandwaves, overfalls, water pipelines and fish farms. It is similarly used for chart features such as fairways, harbour areas, tidal information and for information about the chart such as quality of chart data, overscale areas, etc.
grey	as a background area shade is used with a prominent pattern for no-

	data areas.
blue	as a background area shade is used to distinguish depth zones.
blue	as foreground colour for AIS and VTS information; also reserved for future requirements.
green	is used for the radar image and synthetics, and for buoy and lights colours
blue-green	is used for transferred ARPA.
yellow-green	('moss-green') as a background area shade is used for the intertidal area between high and low waterlines,
yellow	is used as the manufacturer's colour; for the mariner's transparent colour fill; and for buoy and lights colours.
red	is used for the important planned route, for the mariner's danger highlight, and for buoy and lights colours.
orange	is the mariner's colour, for notes, chartwork, chart corrections. The scale bar, north arrow, and mariner's navigation objects such as EBLs and VRMs are also orange.
brown	as a background area shade is used for the land, and dark brown is used for features on land and in the intertidal area that do not have any strong significance for navigation.

C9.7.1 Colour Tokens for S-101 ENC's

The colours in this section are specifically designed for chart display.

Token	Colour, day/night	Usage
CHBLK	black/grey	general
CHGRD	grey dominant	general
CHGRF	grey, faint	general
CHRED	red	general
CHGRN	green	general
CHYLW	yellow	general
CHMGD	magenta, dominant	general
CHMGF	magenta, faint	general
CHBRN	brown	general
CHWHT	white	general
OUTLW	black	symbol outline on sea area background
OUTLL	pale/dark brown	symbol outline on land area background
LITRD	red	red lights
LITGN	green	green lights
LITYW	yellow	white/yellow/orange/amber lights
ISDNG	magenta	isolated danger
DNGHL	red	danger highlight
TRFCD	magenta, dominant	traffic control features
TRFCF	magenta, faint	traffic control features
LANDA	brown	Land areas
LANDF	brown	Landforms, land features
CSTLN	black/grey	Coastline, shoreline constructions
SNDG1	grey	deep soundings > safety depth
SNDG2	black/white	shallow soundings <= safety depth
DEPSC	grey	safety contour
DEPCN	grey	depth contours
DEPDW	white/black	deeper than selected deep contour
DEPMD	pale/dark blue	safety contour to selected deep contour
DEPMS	light/medium blue	shallow contour to selected safety contour
DEPVS	medium/light blue	zero meter contour to shallow contour
DEPIT	yellow-green	high water line to zero meter contour

CHBLK, CHGRD, CHGRF, CHRED, CHGRN, CHYLW, CHMGD, CHMGF, CHBRN, CHWHT - This selection of colours is used in general to design symbols and chart line features as well as fill styles. They are not used in cases where other colours are available for a special usage.

OUTLW, OUTLL - These colours are used to outline symbols depending on which background they are normally shown (water/land).

LITRD, LITGN, LITYW - Light symbols have their own colours to give the opportunity to influence their colour luminance individually. Yellow (**LITYW**) is used for white, yellow, orange and amber lights because it might be difficult to distinguish these colours from each other on a badly calibrated monitor. It also follows the tradition to show up white lights with a yellow flare or coloured arc.

ISDNG - Since the isolated danger symbol forms one of the most important items on the ECDIS screen, it is given a separate colour.

DNGHL - This colour is used for symbology that highlights Mariner selected dangers. The Mariner decides during route planning which features are highlighted by this colour.

TRFCD, TRFCF - Traffic separation schemes are complex chart features. The navigator is confronted with important elements of the schemes and with less important elements as well.

TRFCD is used to distinguish important traffic routeing features.

LANDA - This colour is used for land areas in general.

LANDF - Landforms and land features are given a contrasting brown.

CSTLN - The coastline is a very important feature of the chart. If a radar image is combined with the chart picture it is required that coastline elements clearly show up on top of the green radar picture (see also **RADHI/RADLO**). To have full control over this combination under all conditions (day/night) a separate colour is reserved for coastline features.

SDNG1 - This colour is used for soundings that are deeper than the selected safety depth ("safe" soundings).

SDNG2 - This colour is used for soundings that are shallower than or equal to the selected safety depth ("unsafe" soundings).

DEPSC - This colour is reserved for the selected safety contour.

DEPCN - All depth contours other than the safety contour shall use this colour.

DEPDW, DEPMO, DEPMS, DEPVS, DEPIT - These are depth shades. The depth zones are:

DEPDW: areas deeper than the Mariner-selected deep contour;

DEPMO: areas between deep contour and the Mariner-selected safety contour;

DEPMS: areas between safety contour and the Mariner-selected shallow water contour;

DEPVS: areas between shallow water contour and the low water line (zero meter contour);

DEPIT: areas between zero meter contour and coastline (intertidal).

For route monitoring it may be desirable to distinguish only two water shades, plus **DEPIT**: deeper than own-ship's safety contour and shallower than safety contour. In that case **DEPDW** and **DEPVS** shall be used. At night it may be difficult to distinguish between **DEPMO** and **DEPDW**.

C9.7.2 Radar Image Overlay Colours

Token	Colour	Usage
RADHI	green	high intensity echo or single int. echo
RADLO	green	low intensity echo & target trail
ARPAT	green, dashed	ARPA, target symbols & infos

The radar image overlay can be generated by using either one intensity colour or a range of intensities. The colour for high echo intensity (**RADHI**) shall be used where only one intensity is used. If you prefer to show more than one echo intensity or fading target trails, the corresponding colour intensities shall be interpolated between the colour for high echo intensity (**RADHI**) and the colour for low echo intensity (**RADLO**). A separate colour token is used for ARPA targets and information tagged on them (**ARPAT**).

Optionally, the manufacturer may vary the radar green overlay by making it transparent.

C9.7.3 Mariners' & Navigation Information Colours

Token	Colour	Usage
SCLBR	orange	scalebar
CHCOR	orange	chart corrections
NINFO	orange	Navigators Notes
ADINF	yellow	Mariners' transparent area fill and manufacturers' points and lines

SCLBR Used to generate the scalebar.

CHCOR Hand-entered chart corrections are marked by the colour.

NINFO Mariners' notes of any form (Symbols, Text) are generated using the colour.

C9.7.4 Other Colours

Token	Colour	Usage
RESBL	blue	AIS features and symbols
RESGR	grey	reserved for line features & screened areas
BKAJ1	black	black level test symbol background
BKAJ2	grey	black level test symbol foreground

C9.7.5 Colour Section V / Ship Symbol & Planned Route

Token	Colour,day/night	Usage
SHIPS	black/white	own ship, Co&SpMG vector
PSTRK	black/white	Past Track
SYTRK	grey	Secondary Track
PLRTE	red	planned route & notations
APLRT	orange	alternate planned route

C9.8 Queries

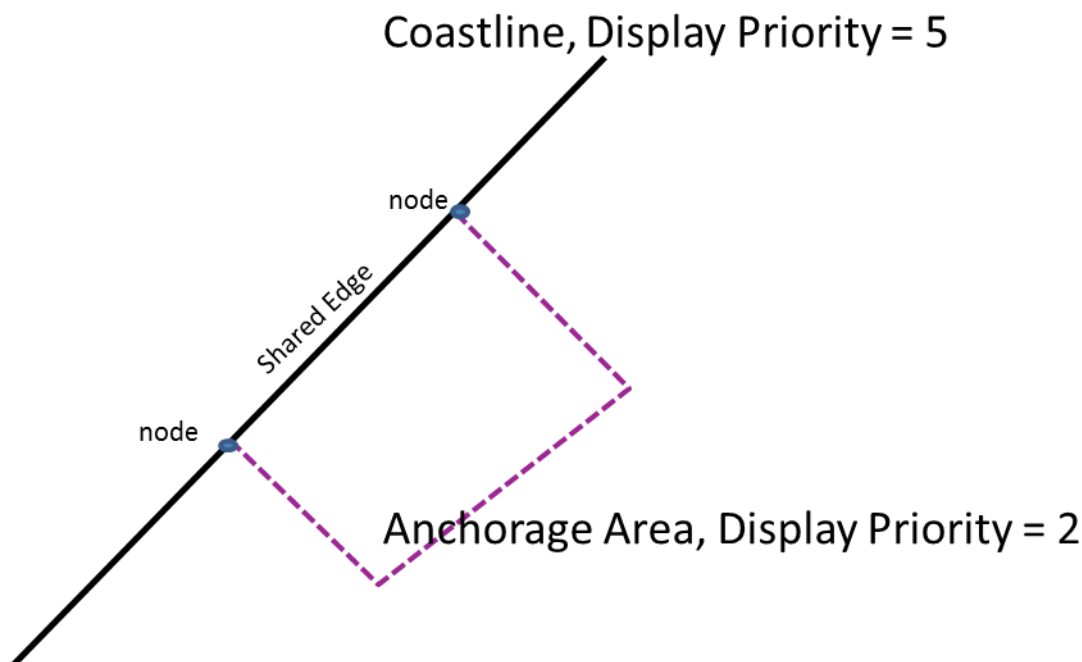
To successfully use S-101 ECDIS must be capable of performing spatial queries on ENC data during import and symbolisation. Spatial query is understood as possibility to inspect graphical position and numerical value of spatial coordinates associated with a charted object. Spatial query could be available as a part of cursor pick or as an independent function.

C9.8 Display Priority, Radar Priority, Display Category, Viewing group

C9.8.1 Display Priority (Drawing Priority)

Display priorities control the order in which the output of the portrayal functions is processed by the rendering engine. Priorities with smaller numerical values will be processed first. In the S-101 Portrayal Catalogue the display priority is known as the drawing priority.

The display priority shall be used to ensure that objects that overlap each other are drawn in the right sequence. Thus, an object with a higher priority shall be drawn after (on top of) an object with a lower display priority. However, if two curve features, or two surface boundaries, or a curve and an surface boundary, are located at the same position and share the same extent (their coordinates are identical), then the line symbolization with the higher display priority shall suppress the line symbolization of the other feature (curve or surface). Therefore only the line symbolization of the feature (curve or surface) of the higher display priority is drawn. Where two features share the same spatial edge and both have the same display priorities each line shall be symbolized.



The coastline feature is symbolized with a solid line while the anchorage area is bordered with a dashed line. Both features share an edge that is part of the coastline. The symbolization of the coastline feature suppresses the border of the anchorage area since the display priority of the coastline symbolization is higher. Note that priorities have to be evaluated again, if the mariners selected viewing scale changes.

This suppression only applies to curve features and surface boundaries. The rule for centred symbols, area patterns and point symbols is that all symbols shall be drawn with the highest priority object being drawn last independent of the geometric primitive (point, curve or surface).

There is one exception to this rule for suppressing overlapping lines. The manual chart correction lines LC(CHCRIDnn) and LC(CHCRDELn) shall coexist with the underlying line. Both LC(CHCRIDnn) or LC(CHCRDELn) and the underlying line shall be drawn.

Overdrawing may be essential, for example in the case of a buoy, and its name and light flare. These are given offsets in the symbol library to avoid the symbols being drawn over each other.

C9.8.2 RADAR Flag

The display plane indicates whether features are shown on top of the raw radar picture. Two different values can occur in this field:

Value	Description
O	puts the object's presentation over radar
U	the presentation is suppressed by radar

As a fail-safe, features are automatically assigned 'O' OVERRADAR if the displayPlane field in the portrayal catalogue is empty.

When the RADAR overlay is present on the ECDIS chart display the OVERRADAR flag takes precedence over the objects display priority.

C9.8.3 Display Mode

The portrayal catalogue assigns every feature a display mode that is based IMO Display Categories (see IMO Performance Standards for ECDIS [2]).

The IMO "display categories" are as follows:

Display Base is that part of the Standard Display which shall be permanently retained on the display (see IMO Performance Standards [2]).

Standard Display information is that part of the SENC which shall be presented when the ECDIS display is first switched on, and at any time by a single operator action (see IMO Performance Standards [2]).

All Other Information includes all SENC information that is not in the Standard Display, to be displayed on demand by the Mariner.

C9.8.3.1 Independent Mariner Selections

There are a number of settings in ECDIS that can be operated by the Mariner that will alter the charted display. Each of these features has a display mode assigned but shall only be shown in that display mode if the Mariner has decided to select this option. Listed alphabetically below are the Mariner selectors that shall be available in ECDIS, the name of the selector in the ECDIS GUI and a functional description. There are a number of other optional extra Mariner selectors that can be included in ECDIS at the bottom of the table.

Clause	ECDIS Implementation	Name of Selector in ECDIS	Function Description
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	Mandatory	Accuracy	Independent pattern selection of CATZOC, viewing group 31010. Symbol LOWACC01, viewing group 31011
	Mandatory	Date dependent	Date Dependent Objects – to turn on and off the display of temporal objects by viewing a date range.
	Mandatory	Full light lines	Full Light Sector Lines
	Mandatory	Highlight date dependent	Indication of date dependent objects – to turn on and off the display of symbol CHDATD01
	Mandatory	Highlight info Highlight document	Additional Information - viewing group 31030 SupplementaryInformation Information type.
	Mandatory	Unknown	Unknown Objects - to turn on the display of objects which are not specified in S-101 standard – viewing group 21010
	Mandatory	Update review	Review of Updates – This function turns on colour highlighting for the update Information feature which have undergone modification in the process of the latest accepted correction;
	Mandatory	Scale min	Turn SCAMIN Off
	Mandatory	Shallow pattern	Shallow Water Pattern
	Mandatory	Shallow water dangers	Isolated Dangers in Shallow Water – to turn on the display of isolated danger objects which are located in the unsafe waters - viewing group 24050
	Optional	Contour label	Contour Labels – to turn on the display of contour labels (incl. label of safety contour) – viewing group 33021, 33022
	Optional	Four shades	Four Colour Depth Shades
	Optional	National language	National Language, text group 31
	Mandatory	Paper chart / simplified symbols	Point symbol style
	Mandatory	Plain / Symbolized boundaries	Line symbol style

C9.8.3.2 Mariners' objects

All Mariners' navigational objects, which are listed in the look-up table under "Non-standard classes", are assigned in the look-up tables to a "Mariners" category.

The display of Mariners' objects is independent of the ECDIS display category (Display Base, Standard and All Other).

C9.8.4 Viewing Groups

The Mariner shall have effective control over which features appear on the display (subject to the overriding requirements of IMO category), as required by the IMO ECDIS Performance Standard section 3.5.

The minimum mandatory ECDIS implementation is described in 14.3 and 14.5.

Viewing groups are 'on' or 'off' switches for use by the Mariner to control the information appearing on the display. An item in the viewing group table may be a chart object; a Mariners' or other time-variable object; a special symbol such as the "depth less than safety contour" pattern; or a non-ENC feature such as the shallow water pattern. In edition 3.3 further 'symbol viewing groups' have been added, to allow auxiliary symbols such as contour labels, the 'low accuracy' symbol, etc., to be switched on or off without affecting the primary symbolisation of the object.

Items in the viewing group tables are arranged in numbered groups (e.g. group 26230 consisting of the items pipeline area and cable area) which in turn are arranged in layers (e.g. layer 26000 consisting of cautionary areas). The groups are arranged by IMO Category, in the sequence of INT 1 [1].

C9.8.4.1 Viewing Groups Layers

DISPLAY BASE	STANDARD DISPLAY	OTHER INFORMATION
00000-09999 reserved for administrative purposes		
10000 reserved 40000 reserved	20000 reserved 50000 reserved	30000 reserved 60000 reserved
11000 A,B information about the chart display 41000 tools	21000 A,B 51000 tool	31000 A,B 61000 tools
12000 C, D, E, F land features 42000 own ship, planned route	22000 C, D, E, F 52000 own ship etc	32000 C, D, E, F 62000 own ship etc
13000 H, I depths & currents 43000 Mariners' features	23000 H,I 53000 Mariners' features	33000 H,I 63000 Mariners' features
14000 J,K,L obstructions, pipelines 44000 other vessels	24000 J,K,L 54000 other vessels	34000 J,K,L 64000 other vessels
15000 M traffic,routes 45000 manufacturers' features	25000 M 55000 manufacturers' features	35000 M 65000 manufacturers' features
16000 N special areas 46000 Mariners' assignments	26000 N 56000 Mariners' assignments	36000 N 66000 Mariners' assignments
17000 P,Q,R,S buoys, beacons,	27000 P,Q,R,S	37000 P,Q,R,S

lights, radar <i>47000 reserved for Mariners' information</i>	<i>57000 reserved</i>	<i>67000 reserved</i>
18000 T,U services & small craft facilities <i>48000 reserved for Mariners' information</i>	28000 T,U <i>58000 reserved</i>	38000 T,U <i>68000 reserved</i>
19000-19999 reserved <i>49000-49999 reserved</i>	29000-29999 reserved <i>59000-59999 reserved</i>	39000-39999 reserved <i>69000-69999 reserved</i>
70000-99999 reserved for future use.		

Numbering scheme for viewing groups (*Mariners' information in italics*)

C9.8.4.1.1 Display Base

RESERVED	
10000-10999	Reserved for chart information
A, B	CHART FURNITURE
11000	Information about the Chart Display
11010	cursor [symbol SY(CURSRA01)]
11020	na (not assigned)
11030	scalebar, latitude scale [SY(SCALEB10),SY(SCALEB11)]
11040	north arrow [SY(NORTHAR1)]
11050	no data [colour NODTA, AP(NODATA03)], unsurveyed (UNSARE), incompletely surveyed area
11060	Non-HO data boundary LC(NONHODAT)
C, D, E, F	TOPOGRAPHY AND INFRASTRUCTURE
12000	Land area
12010	land area (LANDARE)
12200	Dangers above water
12210	bridge (BRIDGE), pylon (PYLONS), overhead cable (CBLOHD), conveyor (CONVYR), overhead pipeline (PIPOHD), offshore platform (OFSPLF)
12400	Shoreline
12410	coastline (COALNE), ice shelf, glacier (ICEARE), shoreline construction (SLCONS), tie-up wall, dolphin (MORFAC), gate (GATCON, pile (PILPNT), crib, wellhead, ice boom (OBSTRN), floating dock (FLODOC), hulk (HULKES), pontoon (PONTON), oilboom (OILBAR), log boom (LOGPON), flood barrage (DAMCON, CATDAM3)
12420	dock (DOCARE), lock (LOKBSN), canal (CANALS), river (RIVERS)
H, I	HYDROGRAPHY
13000	Safety Contour
13010	safety contour (from conditional symbology procedure DEPCNT03)
13020	na
13030	depth area (DEPARE), dredged area (DRGARE),
J, K, L	SUBSEA FEATURES
14000	Dangers under water
14010	isolated underwater dangers in water deeper than the displayed safety contour (rocks, wrecks, obstructions, mooring cables from conditional symbology procedure)
M	TRACKS AND ROUTES
15000-15999	na (not assigned)
N	SPECIAL AREAS
16000-16999	na (not assigned)
P, Q, R, S	AIDS TO NAVIGATION

17000-17999	na (not assigned)
T, U	SERVICES
18000-18999	na (not assigned)
RESERVED	
19000-19999	Reserved for chart information

The groupings are given to illustrate the contents of the Display Base. All objects of this category shall be permanently retained on the ECDIS display.

C9.8.4.1.2 Standard Display

RESERVED	
20000	Reserved for chart information
A, B	INFORMATION ABOUT THE CHART DISPLAY
21000	Information about the Chart Display
21010	Unknown object (magenta question mark)
21020	Generic Object (NEWOBJ01)
21030	Chart scale boundary, overscale data [AP(OVERSCO1)]
21040	na
21050	na
21060	Place-holder for geographic names (LNDRGN, SEAARE)
C, D, E, F NATURAL & MAN-MADE FEATURES, PORT FEATURES	
22000	Major Coastal Features
22010	Lake (LAKARE), sloping ground (SLOGRD), slope top (SLOTOP), dyke (DYKCON), causeway (CAUSWY), dam (DAMCON),
22200	Conspicuous landmarks:
22210	Radar conspicuous object - (any object with attribute CONRAD 1)
22220	Visually conspicuous object (any object with attribute CONVIS 1)
22230	na
22240	Built up area (BUAARE)
H, I	DEPTHS, CURRENTS, etc.
23000	Depths
23010	Area of depth less than the safety contour (DIAMON01 pattern)
23020	na
23030	Swept area (SWPARE)
J, K, L	SEABED, OBSTRUCTIONS, PIPELINES
24000	Seabed dangers
24010	Mooring cables (MORFAC, CATMOR6), (CBLSUB, CATCBL6), tunnel on Seabed (TUNNEL, BURDEP=0), sandwaves (SNDWAV)
M	TRAFFIC ROUTES
25000	Routes and Tracks
25010	Leading line, clearing line (NAVLNE), traffic lane (TSSLPT), deep water route (DWRTPPT), traffic separation area (TSEZNE), traffic separation line (TSELNE), traffic roundabout (TSSRON), traffic crossing (TSSCRS), precautionary area (PRCARE), traffic separation scheme boundary (TSSBND), deep water route centre line (DWRCTCL), two way route part (TWRTPPT), inshore traffic zone (ISTZNE).
25020	Recommended track (RECTRC), recommended traffic lane (RCTLPT), recommended route centreline (RCRTCL)
25030	Ferry route (FERYRT)

25040	Radar line (RADLNE), limit of shore radar (RADRNG)
25060	Radio calling in point (RDOCAL)
N SPECIAL AREAS	
26000	Restricted and Cautionary Areas
26010	Restricted area (RESARE)
26020	na
26030	na
26040	Submarine transit lane (SUBTLN), military practice area (MIPARE), sea plane landing area (SPLARE), offshore production area (OSPARE)
26050	Fairway (FAIRWY)
26150	Caution area (CTNARE)
26200	Information Areas. Protected Areas
26210	Fishing ground (FSHGRD), marine farm (MARCUL), Fishing Facility (FSHFAC)
26220	Anchorage area (ACHARE), anchor berth (ACHBRT),
26230	na
26240	Dumping ground (DMPGRD),
26250	Cargo transhipment (CTSARE), incineration (ICNARE)
26260	Archipelagic sea lane (ASLXIS, ARCSLN)
P, Q, R, S BUOYS & BEACONS, LIGHTS, FOG SIGNALS, RADAR	
27000	Buoys, Beacons, Topmarks, Lights, Fog Signals
27010	Buoy (BOYxxx), light float (LITFLT), mooring buoy (MORFAC, CATMOR7)
27011	Light vessel (LITVES)
27020	Beacon (BCNxxx)
27025	Daymark (DAYMAR)
27030	Distance mark (DISMAR)
27040	Direction of buoyage IALA buoyage regions (M_NSYS)
27050	topmarks (TOPMAR) - for paper chart symbols
27060	gridiron (GRIDRN)
27070	light (LIGHTS)
27080	fog signal (FOGSIG), retro-reflector (RETRFL)
27200	Radar
27210	racon (RTPBCN)
27220	na
27230	radar reflector (RADRFL)
T, U SERVICES & SMALL CRAFT FACILITIES	
28000	Services
28010	pilot boarding point (PILBOP)
28020	signal station, traffic (SISTAT), sig. stn. warning (SISTAW)
RESERVED	
29000	reserved for chart information

C9.8.4.1.3 Other Chart Information

RESERVED	
30000	reserved for chart information
A, B INFORMATION ABOUT THE CHART DISPLAY	
31000	Information about the Chart Display

31010	accuracy of data (M_ACCY), survey reliability (M_SREL), quality of data (M_QUAL)
31011	symbol LOWACC01, identifying low accuracy data, applied to the spatial object of point and area wrecks, rocks and obstructions and to point land areas
31020	nautical publication (M_NPUB)
31030	Supplementary Information
31031	Additional Documents NTXTDS, TXTDSC, PICREP
31040	dataCoverage
31050	na
31060	na
31070	na
31080	magnetic variation (MAGVAR), local magnetic anomaly (LOCMAG)
C, D, E, F NATURAL & MAN-MADE FEATURES, PORT FEATURES	
32000	Natural Features
32010	dunes , hills (SLOGRD), ridge, cliff top (SLOTOP), contours and elevation (LNDELV)
32020	na
32030	trees , vegetation, mangrove (VEGATN), marsh (LNDRGN)
32040	na
32050	river (RIVERS) or lake (LAKARE); also rapids (RAPIDS), waterfall (WATFAL)
32060	Na
32070	tideway (TIDWAY)
32080	na
32200	Shore Structures
32210	na
32220	any of the following not classified as CONVIS1 (conspicuous): landmark (LNDMRK), building (BUISGL), tank, silo, water tower (SILTNK), wall (FNCLNE), fort (FORSTC)
32230	na
32240	airport (AIRARE), runway (RUNWAY)
32250	railway (RAILWY), road (ROADWY), tunnel (TUNNEL), control point (CTRPNT)
32260	na
32270	quarry, refinery, power station, tank farm, wind farm, factory, timber yard (PRDARE)
32280	na
32400	Port Features
32410	harbour type (HRBFAC), customs check point (CHKPNT) [note: "small craft facilities" (SMCFAC) is in group 38210]
32420	na
32430	na
32440	berth number (BERTHS), mooring facility (such as bollard) (MORFAC), , gate (such as lock gate) (GATCON) , dry dock (DRYDOC), crane (CRANES)
32450	na
32460	na
H, I DEPTHS, CURRENTS ETC	
33000	Depths, Currents, Tide rips, etc
33010	Soundings (SOUNDG)
33020	depth contours (DEPCNT) other than the safety contour
33021	label for the safety contour

33022	label for contours other than the safety contour
33030	na
33040	water turbulence (WATTUR)
33050	tidal information (T_HMON, T_NHMN, T_TIMS)
33060	current and tidal stream information (CURENT, TS_FEB, TS_PAD, TS_PNH, TS_PRH, TS_TIS)
J, K, L SEABED, OBSTRUCTIONS, PIPELINES	
34000	Seabed Information: rocks, wrecks & obstructions, pipes & cables
34010	nature of seabed (SBDARE)
34020	spring (SPRING), sea weed (WEDKLP)
34030	Pipeline area (PIPARE), cable area (CBLARE)
34040	na
34050	rocks (UWTROC), wrecks (WRECKS), obstructions (OBSTRN), which are not a danger to own-ship's navigation (these are all Display Base if a danger to own-ship)
34051	non-dangerous rocks (UWTROC), wrecks (WRECKS) and obstructions (OBSTRN) which have a VALSOU attribute and are not a danger to own-ship's navigation (these objects are all Display Base if a danger to own-ship)
34060	na
34070	submarine cable (CBLSUB), submarine pipeline (PIPSOL)
M TRAFFIC ROUTES	
35000	Routes
35010	na
N SPECIAL AREAS	
36000	Administrative Areas, (by cursor enquiry)
36010	continental shelf (COSARE),
36020	harbour area (HRBARE) free port area (FRPARE), customs zone (CUSZNE)
36030	na
36040	fishery zone (FSHZNE)
36050	contiguous zone (CONZNE), exclusive economic zone (EXEZNE), national territorial area (NATARE), territorial sea (TESARE), territorial sea baseline (STSLNE), administration area (ADMARE)
P, Q, R, S BUOYS & BEACONS, LIGHTS, FOG SIGNALS, RADAR	
37000-37999	na
T, U SERVICES & SMALL CRAFT FACILITIES	
38000	Services
38010	radar station (RADSTA), radio station (RDOSTA)
38020	na
38030	coastguard station (CGUSTA), rescue station (RSCSTA)
38200	Small craft facilities
38210	small craft facilities (SMCFAC)
RESERVED	
39000	reserved for chart information

C9.8.4.2 Mariner's Information – Display Base

RESERVED	
40000	Reserved for Mariners' information
TOOLS	
41000-41999	na

OWN-SHIP, PLANNED ROUTES, PAST TRACKS	
42000	Own ship
42010	Own ship (ownship), symbol or scaled version, together with heading line, beam bearing line and course and speed vector
42200	Selected Planned Route
42210	legline (leglin, select 1), way points (waypnt, select 1)
42220	Course to make good for selected leglines
MARINERS' FEATURES	
43000	na
OTHER VESSELS	
44000	na
MANUFACTURERS' FEATURES	
45000-45999	Manufacturers' Features
MARINERS' ASSIGNMENTS TO DISPLAY BASE	
46000-46999	Mariners' and manufacturers' objects assigned to Display Base by the Mariner
RESERVED	
47000-49999	reserved for Mariners' information

C9.8.4.3 Mariner's Information – Standard Display

RESERVED	
50000	reserved for Mariners' information
TOOLS	
51000-51999	na
OWN-SHIP, PLANNED ROUTES, PAST TRACKS	
52000	Notations on Selected Planned Route
52010	wheel-over line (wholin), selected route
52020	course to make good on leglines (leglin, select 1) of selected route
52030	planned position (pinpos), distance to go, and other notations on selected planned route
52200	Alternate Planned Route
52210	leglin (leglin, select 2), waypoint (waypnt, select 2) of alternate planned route
52220	na
52230	wheel-over line (wholin), alternate route
52240	other notations, alternate route
52400	Past Track
52410	event (events)
52420	na
52430	primary past track (pastrk, catpst 1)
52440	notations on primary past track
52450	na
52460	secondary past track (pastrk catpst 2)
MARINERS' FEATURES	
53000	Mariners' features
53010	danger highlight (dnghlt)
53030	Mariners' information note (marnot catnot 1)
53040	Mariners' cautionary note (marnot catnot 2)
53050	Mariners' feature (marfea)
53060	na
53070	na

53080	tidal current observed (tidcur, catcur 2), tidal current predicted (tidcur, catcur 1)
OTHER VESSELS	
54000	Other Ships
54010	other ships (vessels) from radar
54020	notations on other ships (acqsta)
54030	other ships from other sources or undefined sources

MANUFACTURERS' FEATURES	
55000	Manufacturers' Features
55010	manufacturers' feature (mnufea, catnot 1)
55020	manufacturers' feature (mnufea, catnot 2)
MARINERS' ASSIGNMENTS TO STANDARD DISPLAY	
56000-66999	Mariners' and manufacturers' Objects Assigned to Standard Display by the Mariner
RESERVED	
57000-59999	reserved for Mariners' information

C9.8.4.4 Mariner's Information – Display Base

RESERVED	
60000	reserved for Mariners' information
TOOLS	
61000	Tools
61010	electronic bearing line (ebline), variable range marker (vrmark)
61020	na
61030	range rings (rngrng)
61040	cursor, style B (cursor, cursty2)
61050	cursor reference point (refpnt)
OWN-SHIP, PLANNED ROUTES, PAST TRACKS	
62000	Position fixes
62010	position fix (positn)
62020	position line (poslin)
MARINERS' FEATURES	
63000-63999	na
OTHER VESSELS	
64000-64999	na
MANUFACTURERS' FEATURES	
65000-65999	Manufacturers' Features
MARINERS' ASSIGNMENTS TO OTHER INFORMATION	
66000-66999	Mariners' and manufacturers' objects assigned to other information by the Mariner
RESERVED	
67000-69999	reserved for Mariners' information

C9.8.5 ECDIS Viewing Group Implementation

For standardization of the ECDIS Human Machine Interface (HMI) and to facilitate generic training of Mariners as a minimum the following viewing group layers shall be implemented to control display of charted objects. An ECDIS may provide more display on/off controls than are available in this table, but OEM shall use the viewing group layer names contained in this table. The viewing group names are derived from the IMO PS.

Viewing Group Layer	Name of viewing group layer in the ECDIS	Viewing groups included
1	Display Base	10000 - 19999
Standard Display:		
2	Drying line	22010
3	Buoys, beacons, aids to navigation	21020, 22200 – 22240, 27000, 27010, 27011, 27020, 27025, 27040, 27050, 27070, 27080, 27200, 27210, 27230, 27030, 27060
3.1	Buoys, beacons, structures	21010, 21020, 22200 - 22240, 27000-27050, 27080, 27200 – 27230, 27030, 27060
3.2	Lights	27070
4	Boundaries and limits	23030, 26050, 26220, 26240, 26250
5	Prohibited and restricted areas	26000, 26010, 26040
6	Chart scale boundaries	21030
7	Cautionary notes	26150
8	Ships' routing systems and ferry routes	25010-25060
9	Archipelagic sea lanes	26260
10	Miscellaneous	Switches on and off all not covered objects by viewing group layers 20000-29999
Other		
11	Spot soundings	33010
12	Submarine cables and pipelines	34030, 34070
13	All isolated dangers	34050, 34051
14	Magnetic variation	31080
15	Depth contours	33020
16	Seabed	34010, 34020, 33040
17	Tidal	33050, 33060
18	Miscellaneous	Switches on and off all not covered objects by viewing group layers 30000-39999 or not covered cases by independent mariner selections (see 10.3.4.4)

C9.9 Display of features – Date Dependent and Display Scale

C9.9.1 Date dependent ENC Features

There are a number of objects within the Marine environment, which are seasonal, such as racing buoys. These objects are only to be displayed over a certain period, S-101 uses the complex attribute **periodicDateRange** with the sub attributes **dateStart** and **dateEnd** to indicate the periodic nature of the feature. Other objects, such as traffic separation schemes, use the complex attribute **fixedDateRange** with the sub attributes **dateStart** and **dateEnd** to indicate their introduction or removal. In order for the Mariner to receive important changes to traffic separation schemes before the event Hydrographic Offices are required to provide updates or new editions containing the alterations at least one month before they come into force. Any S-101 feature with one of the above complex attributes must not be displayed outside its effective dates unless requested by the Mariner.

To provide the Mariner with effective route planning capabilities and for the look-ahead function during route monitoring ECDIS must display date dependent chart data based on a Mariner selected date or date range (start viewing date and end viewing date).

During route planning and monitoring the Mariner must be able to select a date or date range to display all date dependent chart objects. The display of date dependent information is indicated by the symbol SY(CHDAT01).

All objects for which any of the values for the complex attributes **periodicDateRange** and **fixedDateRange** are within the Mariner selected date range shall be indicated using SY(CHDATD01)

Example: A new traffic separation scheme is coming into effect on 01.01.2013, it has been encoded by the ENC producer using the attribute date start (DATSTA). The current date is 12.12.2012 and the Mariner is planning a route that will cross this area over the effective start period.

The ECDIS shall be capable of providing the Mariner the ability to set the date he will be in the area (02.01.2013) and the system shall show the new traffic scheme.

C9.9.2 Scale-Dependent Features

To reduce screen clutter most objects within ENC will carry the attribute **scaleMinimum** to specify the smallest display scale at which they shall be drawn. At display scales smaller than **scaleMinimum** the feature must not be drawn. For example, an object with a **scaleMinimum** value of 50,000, indicating a scale of 1/50,000, shall not be drawn on an ECDIS display of 1/60,000.

C9.10 IMO Presentation Instructions not handled by the portrayal catalogue

In some cases S-101 does not provide a symbology instruction in the portrayal catalogue that specifies how to present a specific feature on the ECDIS screen. The reason is, that such a feature cannot be clearly identified as an S-101 feature class or it appears to be illogical to include it to the Mariners' navigational feature classes.

Therefore, the following presentation instructions are in free text in order to assist the manufacturer to set up a satisfactory and comprehensive ECDIS display.

C9.10.1 Scalebar and Latitude Scale

For **maximumDisplayScales** larger than 1/90,000 (e.g. a scale of 1/50,000) draw symbol 'SCALEB10' on the left side of the chart display, bottom justified and 3mm in from the border of the display. Make sure the symbol is properly sized by your software to represent 1 nautical mile (1852 m) at the scale of the display. For display scales of 1/80,000 or smaller (e.g. 1/250,000) use symbol 'SCALEB11', similarly located, and scaled to represent 10 miles at the scale of the display.

Symbol	SCALEB10 SCALEB11
Display Priority	9
Over Radar	O
Display Category	Base
Viewing Group	11030

C9.10.2 North Arrow

Use symbol 'NORTHAR1' to indicate true north. Place it in the top left corner of the chart display, inside the scalebar. Rotate the symbol to true north if the display is other than north up, and make sure it is clear of the scalebar even if the latter extends the full height of the display

Symbol	NORTHAR1
Display Priority	9

Over Radar	O
Display Category	Base
Viewing Group	11040

C9.10.3 Graticule

If the ECDIS shows a graticule (IMO PS [2]) the lines shall be one unit wide, CHBLK.

C9.10.4 Display Mode

The ECDIS manufacturer shall provide the indication of display mode required in the display base by IMO PS [2].

C9.10.5 Shallow Water Pattern

When the entire water area on the ECDIS display is of less depth than the safety contour, it is not possible for the Mariner to easily detect this problem. The issue is exacerbated when the ECDIS is set to night mode due to the small differences between the depth area shades in the ECDIS chart display. Therefore S-101 provides a faint lattice pattern DIAMOND1 to distinguish shallow water.

The Mariner shall must be provided with a selection to turn the shallow water pattern on or off from within the ECDIS

Symbol	DIAMOND1
Display Priority	3
Over Radar	S
Display Category	Standard
Viewing Group	23010

C9.10.6 Black Level Adjustment Symbol

Unless the brightness and contrast controls of the monitor, are properly adjusted there is a danger that information may be lost from the chart display, particularly at night. Symbol BLKADJ is provided for checking correct adjustment and for re-adjusting as necessary. It shall be available for call-up by the Mariner as required.

C9.10.7 Detection and Notification of Navigational Hazards

The IMO Performance Standard for ECDIS MSC.232(82) clauses, 11.3.5 Route planning states;

“An indication should also be given if the Mariner plans a route closer than a user-specified distance from a point object, such as a fixed or floating aid to navigation or isolated danger”.

Clause 11.4.6 Route monitoring states;

“An indication should be given to the Mariner if, continuing on its present course and speed, over a specified time or distance set by the Mariner, own ship will pass closer than a user-specified distance from a danger (e.g. obstruction, wreck, rock) that is shallower than the Mariner’s safety contour or an aid to navigation”.

The following table lists the S-101 features and their attributes that satisfy the conditions above and shall precipitate an indication within the ECDIS. The point, curve or surfaces shall be graphically

indicated using the instructions contained in the portrayal catalogue named “indhlt”. “indhlt” is not an ENC charted feature class, but an feature that shall be created by the ECDIS. See Fig XX for example.

S-101 Features	Condition (if any)	Geometric primitive
BeaconCardinal		POINT
BeaconIsolatedDanger		POINT
BeaconLateral		POINT
BeaconSafeWater		POINT
BeaconSpecialPurpose		POINT
BuoyCardinal		POINT
BuoyInstallation		POINT
BuoyIsolatedDanger		POINT
BuoyLateral		POINT
BuoySafeWater		POINT
BuoySpecialPurpose		POINT
SpanOpening		POINT,CURVE, SURFACE
CableOverhead		LINE
Daymark		POINT
PipelineOverhead		LINE
Conveyor		LINE, AREA
MooringFacility		POINT,CURVE, SURFACE
VirtualAISaidToNavigation		POINT
FishingFacility		POINT,CURVE, SURFACE
IceArea		SURFACE
LightFloat		POINT
LightVessel		POINT
LandArea		POINT, CURVE
LogPond		POINT, SURFACE
OffshoreOilPlatform		POINT, SURFACE
OilBarrier		CURVE
PilePoint		POINT
Pylongs		POINT, SURFACE
Obstruction	defaultClearanceDepth < safety contour value	POINT,CURVE, SURFACE
UnderwaterRock	defaultClearanceDepth < safety contour value	POINT
Wrecks	defaultClearanceDepth < safety contour value	POINT, SURFACE
Sounding	EXPSOU=2 and VE3D subfield< safety contour value	POINT

* The safety contour value is set by the user.

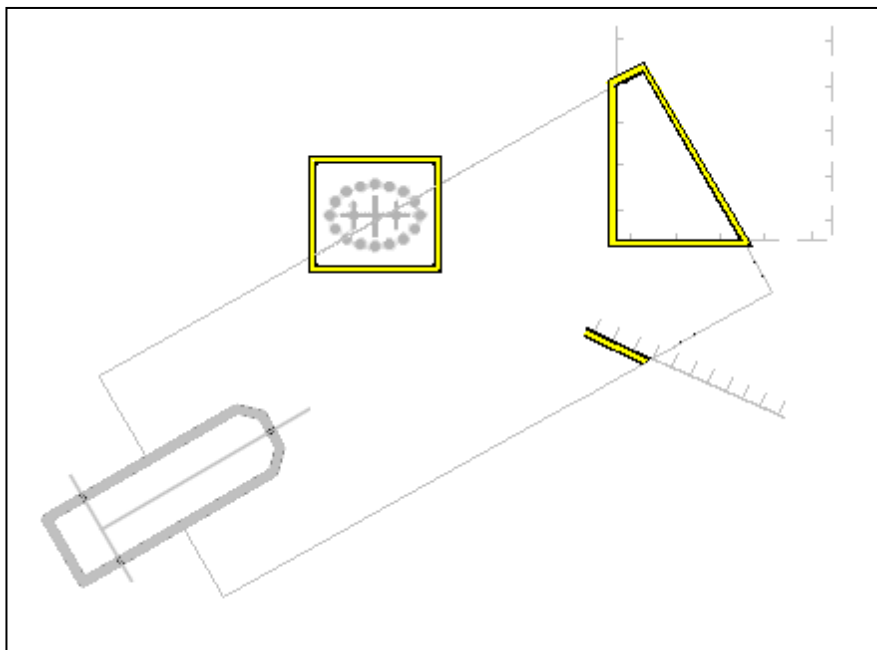


Fig 7. Example of indication highlight in ECDIS 10.5.9 and 10.5.10

C9.10.7 Detection of Areas, for which Special Conditions Exist.

The IMO Performance Standard for ECDIS MSC.232(82) clause 11.3.5 Route Planning states;

“An indication should be given if the Mariner plans a route closer than a user-specified distance from the boundary of a prohibited area or a geographic area for which special conditions exist.”

Clause 11.4.4 Route Monitoring states;

“ECDIS should give an alarm or indication, as selected by the Mariner, if, within a specified time set by the Mariner, own ship will cross the boundary of a prohibited area or area for which special conditions exist”.

The IMO Performance Standard Appendix 4 specifies the following areas which ECDIS shall detect and provide an alert or indication.

- Traffic separation zone
- Inshore traffic zone
- Restricted area
- Caution area
- Offshore production area
- Areas to be avoided
- Military practice area
- Seaplane landing area
- Submarine transit lane
- Anchorage area
- Marine farm/aquaculture
- PSSA (Particularly Sensitive Sea Area)

The following table provides an authoritative mapping between the areas identified within the IMO Performance standard for ECDIS and S-101 feature, their attributes and geometric primitives. The

point, curve or surface features shall be graphically indicated using the presentation named as “indhlt” in the look-up tables.

IMO Special condition	S-101 Feature	Attribute	Geometry
Traffic separation zone	TrafficSeparationZone		SURFACE
Inshore traffic zone	InshoreTrafficZone		SURFACE
Restricted area	RestrictedArea	restriction !=14 and categoryOfRestriction != 28	SURFACE
Caution area	CautionArea		SURFACE, POINT
Offshore production area	OffshoreProductionArea		SURFACE
Areas to be avoided	RestrictedArea	restriction = 14	SURFACE
Military practice area	MilitaryPracticeArea		SURFACE, POINT
Seaplane landing area	SeaplaneLandingArea		SURFACE, POINT
Submarine transit lane	SubmarineTransitLane		SURFACE
Anchorage area	AnchorageArea		SURFACE, POINT
Marine farm/aquaculture	MarineFarmCulture		SURFACE, CURVE, POINT
PSSA (Particularly Sensitive Sea Area)	RestrictedArea	categoryOfRestriction = 28	SURFACE

C9.10.8 Visualization of the Safety Contour

The safety contour is defined as an edge between safe and unsafe skin of the earth objects.

C9.10.9 Detection of Safety Contour

The IMO Performance Standard for ECDIS MSC.232(82) clause 11.3.4 Route Planning states;

“An indication is required if the Mariner plans a route across an own ship's safety contour”

Clause 11.4.3 Route Monitoring states;

*“ECDIS **should** give an alarm if the ship, within a specified time set by the Mariner, is going to cross the safety contour”.*

The following table specifies the S-101 features, conditions and geometry that constitute the safety contour and shall therefore be used when raising the safety contour alarm.

The point, line or area shall be graphically indicated using the presentation named as “dnghlt” in the portrayal catalogue.

S-101 Feature	Condition	Geometry
DepthArea	*DEPARE03 “UNSAFE=TRUE”	SURFACE
DredgedArea	*DEPARE03 “UNSAFE=TRUE”	SURFACE
FloatingDock	-	CURVE, SURFACE
Hulkes	-	POINT, SURFACE
LandArea	-	POINT,CURVE, SURFACE
Pontoon	-	CURVE, SURFACE

UnsurveyedArea	-	SURFACE
ShorelineConstruction	-	POINT,CURVE, SURFACE

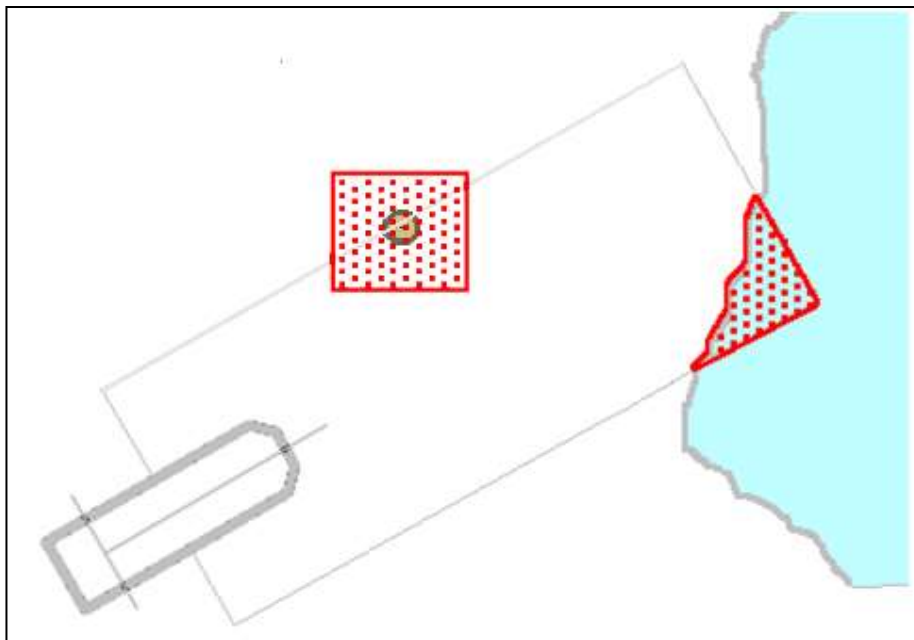


Fig 8. Example Danger Highlight in ECDIS

C9.11 Hydrographic Office Specified Display Features

C9.11.1 Supplementary Information

Additional chart content is encoded using the information type **SupplementaryInformation**. This information type is associated to S-101 features using the information association, **AdditionalInformation**. The information type **SupplementaryInformation** carries attributes that must be discoverable.

The pivot point of SY(INFORM01) shall be placed at the position of a point object, at the midpoint of a line object, or at the centre of an area object. SY(INFORM01) is intended as a temporary overlay. The display priority is 8, overradar, category other, viewing group 31030.

Symbol (SY)	INFORM01
Display Priority	8
Over Radar	O
Display Category	Other
Viewing group	31030

NOTE The ECDIS manufacturers shall provide appropriate solutions that enable PICREP and other ancillary files to be displayed without affecting the night vision of the user.

C9.11.2 Display of National Language Attributes and Content

In S-101 national language may be encoded using the complex attributes **featureName**, **Information**, and **TextualDescription**. A sub attribute of the complex is **language**, which will enable the hydrographic office to note that the text is in the national language in addition to English. Information contained in the secondary **featureName** or **Information** can be encoded in a number of formats and many IHO member states encode such fields in their data. National language information is not covered by the ECDIS Performance Standard, however, it is strongly recommended that OEMs support all text formats contained in the national language attributes and files.

C9.11.3 ECDIS Legend

The ECDIS chart legend containing the following elements shall be available for display at the position selected by the Mariner. The following table indicates which ENC data elements shall be used.

ECDIS Legend	Values
Units for depth	AXUM subfield in the CSAX field
Units for height	AXUM subfield in the CSAX field
Note: Units for depth and height: although the ENC Product Specification of S-101 does not allow any other than metric depths and heights, these two elements shall be stated for clarity for the Mariner	
Scale of display	Selected by Mariner. (The default display scale is defined by the maximumDisplayScale , contained within the ENC metadata file).
Data quality indicator	a. CATZOC attribute of the M_QUAL object for bathymetric data. b. POSACC attribute of the M_ACCY object (if available) for non-bathymetric data.
Note: Due to the way quality is encoded in the ENC, both values (a and b) shall be used.	
Sounding/vertical datum	The soundingDatum and verticalDatum fields of the metadata catalogue for the dataset or the verticalDatum attribute of the SoundingDatum feature and VerticalDatum feature when available. (verticalDatum attributes of individual objects shall not be used for the legend.)
Horizontal datum	WGS84
Value of safety depth	Selected by Mariner. Default is 30 metres.
Value of safety contour	Selected by Mariner. Default is 30 metres.
Note: If the Mariner has selected a contour that is not available in the ENC and the ECDIS displays a default contour, both the contour selected and the contour displayed shall be quoted.	
Magnetic variation	referenceYearForMagneticVariation , valueOfAnnualChangeInMagneticVariation , valueOfMagneticVariation Item shall be displayed as;

	valueOfMagneticVariation referenceYearForMagneticVariation (referenceYearForMagneticVariation) e.g., 4°15W 1990 (8'E)
Date and number of latest update affecting chart cells currently in use.	ISDT and UPDN subfields of the DSID field of the last update cell update file (ER data set) applied.
Edition number and date of the ENC.	EDTN and UADT subfields of the DSID field of the last EN data issue of current ENC issue of the ENC set.
Chart projection	Projection used for the ECDIS display (e.g., oblique azimuthal). This shall be appropriate to the scale and latitude of the data in use.

The list above is the minimum that shall be available, but the complete list need not always be shown. Individual items **may** be picked by the Mariner for display for a period; examples are magnetic variation, data quality for depths etc.

C9.11.4 Light Description Text Strings

This **section** defines the syntax, layout and map of the S-101 attributes to the ECDIS text string.

To produce textual light descriptions in ECDIS, the ECDIS system shall use an abbreviated form of the S-101 attributes of the Lights feature in a particular order. The number next to the attribute denotes the draw order in which the ECDIS shall output the light description text string. Overall structure:

- 1 Category of Light
- 2 Light Characteristic
- 3 Signal Group
- 4 Colour
- 5 Signal Period
- 6 Height (HEIGHT)
- 7 Value of Nominal Range (VALNMR)
- 8 Status (STATUS)

NOTE: **lightCharacteristic**, **signalGroup**, and **signalPeriod** are part of the **rhythmOfLight** complex attribute.

The following tables define a map between the ENC attribute values and the required ECDIS textual output.

S-101 Attribute CATLIT - Category of Light

ENC Input		ECDIS Output
S-101 Attribute Code ID	S-101 Category of Light Attribute Value	Abbreviation
1	directional function	Dir
5	aero light	Aero
7	fog detector light	Fog-Det Lt

NOTE In S-101 Fog Detector Light is a separate feature

S-101 Attribute - Status

ENC Input		ECDIS Output
S-101 Attribute Code ID	S-101 Status Attribute Value	Abbreviation
2	occasional	occas
7	Temporary	temp
8	Private	priv
11	extinguished	exting
17	un-watched	U

S-57 Attribute - Light Characteristic

ENC Input		ECDIS Output
S-101 Attribute Code ID	S-101 Light Characteristic Attribute Value	Abbreviation
1	Fixed	F
2	Flashing	FI
3	long-flashing	LFI
4	quick-flashing	Q
5	very quick-flashing	VQ
6	ultra quick-flashing	UQ
7	Isophased	Iso
8	Occulting	Oc
9	interrupted quick-flashing	IQ
10	interrupted very quick-flashing	IVQ
11	interrupted ultra quick-flashing	IUQ
12	Morse	Mo
13	fixed/flashing	FFI
14	flash/long-flash	FI+LFI
15	occulting/flashing	OcFI
16	fixed/long-flash	FLFI
17	occulting alternating	AIOc
18	long-flash alternating	AILFI
19	flash alternating	AIFI
20	group alternating	AI
25	quick-flash plus long-flash	Q+LFI
26	very quick-flash plus long-flash	VQ+LFI
27	ultra quick-flash plus long-flash	UQ+LFI
28	Alternating	AI
29	fixed and alternating flashing	AIF FI
Wrong	alternating occulting/flashing	AIOc FI

Units of measure suffixes

S-101 Attribute	Description	Units of Measure
Signal Period	Seconds	s
Height	Metres	m
Value of Nominal Range	Miles	M

When the signal group value is set to or include “()” and/or “(1)” there is no requirement for this to be populated in the light description text. Only when the signal group value differs from the above mentioned values shall the value be output on the ECDIS screen, this follows the paper chart convention Mariners are used to seeing.

The default presentation for each numeric value: signal period, height and value of nominal range is no decimals. If the value of the attribute has non-zero decimal part then the value is displayed to one decimal place.

Example: Given a light with the following attributes;

Feature	LIGHTS
Light Characteristic	Flashing
Signal Group	(1)
Colour	White
Signal Period	30 seconds
Height	7 metres
Value of Nominal Range	10 miles

The ECDIS shall display the lights textual description as follows: **FL W 30s7m10M**

C9.12 Displaying Manual and Automatic Updates and Added Chart Information

C9.12.1 Manual Updates

Manual updates of ENC information shall be displayed using the same symbology as ENC information and shall be distinguished from ENC information as follows:

C9.12.1.1 Added Feature

Point object: superimpose SY(CHCRIDnn)*

Line object: overwrite with line LC(CHCRIDnn)*

Area object: overwrite area boundary with line LC(CHCRIDnn) and superimpose SY(CHCRIDnn) on any centred symbol.

C9.12.1.2 Deleted Feature

The object shall remain on the display and shall be marked as follows:

Point object: Superimpose SY(CHCRDELn)*

Line object: Overwrite with line LC(CHCRDELn)* (do not remove the original line)

Area object: Overwrite area boundary with line LC(CHCRDELn) and superimpose SY(CHCRDELn) on any centred symbol.

*SY(CHCRIDnn) means the current version of symbol CHCRID, i.e., CHCRID01 in 1997. CHCRID and CHCRDEL symbols have the category and viewing group of the object they are attached to, display priority «8», radar priority «O».

C9.12.1.3 Moved Feature

As for deleted feature, followed by added feature.

C9.12.1.4 Modified Feature

- a) If the only modification is an addition (e.g., an existing buoy has a retro-reflector added with no other change): superimpose SY(CHCRIDnn) or LC(CHCRIDnn)
- b) If the only modification is a deletion of a part (e.g., an area has a «fishing prohibited» restriction removed), then this creates both a change and a deletion and both shall be symbolized:
 - Point:* superimpose SY(CHCRIDnn) and SY(CHCRDELn)
 - Line:* overwrite with LC(CHCRIDnn) and LC(CHCRDELn)
 - Area:* overwrite the boundary with LC(CHCRIDnn) and LC(CHCRDELn) and also superimpose SY(CHCRIDnn) and SY(CHCRDELn) on any centred symbol.
- c) If the modification is an addition and a deletion then it is handled as in 10.7.1.4 b above.

A deleted feature shall appear on the display only when its IMO category and viewing group are displayed.

A manually updated feature must be capable of the same performance in feature selection, response to cursor-picking, etc., as an ENC feature. In addition, it shall provide updating information (identification and source of update, when and by whom entered, etc.) on cursor picking.

C9.12.2 Identifying Automatic Chart Corrections On Mariners Demand

The ECDIS manufacturer shall provide a means of identifying chart corrections to the SENC on demand by the Mariner.

On mariners demand automatic chart corrections of ENC information shall be highlighted as follows:

S-101 utilizes the UpdateInformation feature that is associated using the updatedInformation association to indicate which features have been affected by the ENC update. This feature can be either a point, curve or surface and contains a description what has been updated.

C9.12.3 Non-HO (Non-ENC) Chart Information

Limited non-HO data added to existing HO ENC data to augment the chart information shall be distinguished from the HO-ENC information as follows:

- Point object: superimpose SY(CHCRIDnn)
- Line object: overwrite with line LC(CHCRIDnn)
- Area object: overwrite area boundary with line LC(CHCRIDnn) and superimpose SY(CHCRIDnn) on any centred symbol.

Non-HO data shall be distinguished from manually updated chart information, which uses the same identifiers, by cursor picking.

Non-HO chart information **may** be updated by any systematic procedure. A record of updates shall be maintained.

The Mariner shall be able to remove all non-HO chart information if the need should arise.

C9.13 Cursor Pick and Interface Panel Display

There are a number of rules that must be applied to all ECDIS cursor pick reports.

No	Cursor Pick Rules
1	Full S-101 feature and Attribute names shall be displayed
2	Enumerate value names shall be displayed
3	There shall not be any padding of attribute values, e.g. a height of 10 metres shall not be padded to 10.000000 metres as this could potentially confuse or mislead the Mariner.
4	Units of measure shall be included after all attribute values which are weights or measures.
5	Cursor enquiry shall extend to include both information association, feature associations, aggregations and compositions, that may carry additional information such as a featureName .
6	Dates shall be given in the form "Day Month Year" DD-MMM-YYYY. JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC
7	The pick report shall only return information about the visible objects on the ECDIS display. If the viewing group is turned on all objects even no symbol objects without visible presentation within that viewing group are available via the cursor pick report
8	Cursor enquiry shall extend to the spatial object, which carries accuracy attributes qualityOfPosition and positionalAccuracy . It shall

C9.13.1 Pick Report Descriptions

A plain language explanation of each symbol is included in the portrayal catalogue. This gives the Mariner quick and understandable information which is not always obvious from the object class and attribute information. The manufacturer shall always provide explanations to the Mariner in response to a cursor pick on the symbol.

Attribute values provided in addition to the above explanation shall be connected to their meaning, and the definitions shall also be available.

C9.13.2 User Defined Cursor Pick Parameters

The Mariner shall be able to configure the content displayed in the pick report.

C9.13.3 Sorting by Significance

A general cursor enquiry shall be sorted by the drawing priority of the feature as defined in the portrayal catalogue. When the drawing priority of features is equal the geometric primitive will be used to order the information, points followed by curves and finally surfaces.

C9.13.4 Hover-over Function

OEMs may wish to include hover-over functions for Mariners to access important charted feature details without having to select a pick report. If this function is implemented within an ECDIS the Mariner shall be able to configure the system function on and off.

The hover-over function shall only be used on the following features and for the symbols SYINFORM01 and **(SY - Pol's new date symbol)**;

Features	S-57 Acronym
Lights	LightsAllAround LightsSectored LightFogDetector LightAirObstruction
Beacon, cardinal	BeaconCardinal
Beacon, isolated danger	BeaconIsolatedDanger
Beacon, lateral	BeaconLateral
Beacon, safe water	BeaconSafeWater
Beacon, special purpose/general	BeaconSpecialPurpose
Buoy, cardinal	BuoyCardinal
Buoy, installation	BuoyInstallation
Buoy, isolated danger	BuoyIsolatedDanger
Buoy, lateral	BuoyLateral
Buoy, safe water	BuoySafeWater
Buoy, special purpose/general	BuoySpecialPurpose
Landmarks	Landmark

C9.13.5 Unknown Attributes

When the ECDIS encounters an unknown attribute not present in the S-101 feature catalogue its value shall be available via the ECDIS cursor pick.

C9.14 Tidal Stream Panels : S-101 feature TidalStreamPanelData

When a TidalStreamPanelData feature is encoded within ENC, the data from the attribute tidalS shall be formatted for display in the ECDIS cursor pick report. The following section describes the template that shall be used for displaying the values.

S-101 has modelled the tidal stream panel data as a series of complex attributes. Complex attributes are in italics and encoded values are in blue text.

Tide Stream Panel Data (feature)			
Station name	PLYMOUTH (DEVONPORT)		
Station number	0014		
<i>Tide stream panel values</i>			
Reference tide	high water		
Reference tide type	springs		
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	113
	Time relative to tide		-6
	Velocity maximum		0.1
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	332
	Time relative to tide		-5
	Velocity maximum		0.6
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	331

	Time relative to tide		-4
	Velocity maximum		1.1
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	342
	Time relative to tide		-3
	Velocity maximum		1.0
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	347
	Time relative to tide		-2
	Velocity maximum		0.7
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	333
	Time relative to tide		-1
	Velocity maximum		0.5
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	317
	Time relative to tide		0
	Velocity maximum		0.3
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	178
	Time relative to tide		1
	Velocity maximum		0.3
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	146
	Time relative to tide		2
	Velocity maximum		0.6
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	140
	Time relative to tide		3
	Velocity maximum		1.0
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	143
	Time relative to tide		4
	Velocity maximum		1.1
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	143
	Time relative to tide		5
	Velocity maximum		0.8
<i>Tide stream value</i>	<i>Orientation</i>	Orientation Value	138
	Time relative to tide		6
	Velocity maximum		0.3

C.11 Data Product Delivery

C.11.1 Introduction

C.11.2 Exchange Set

The ECDIS must be able to carry multiple versions of the feature catalogue. It is keyed to the version number of the Product Specification and Catalogues. For example, it will need to carry all valid catalogues that are to be used for datasets that have been produced from a different edition of the product specification. Need to clarify that only major catalogue changes need to have multiple catalogues, but minor changes should not have to need a replacement catalogue.

Major – what is a major change – Everything needs to be replaced.

Minor – correction which would warrant a new catalogue that sits next to the old one because you can't cater for legacy data.

Very Minor

Scenarios –

New Attribute

New ennumarant

New Feature

Feature changes type.

C.11.3 Dataset

C.11.3.1 Data Sets

NEED WORKED EXAMPLES OF NON OVERLAPPING DATASETS

Placeholder for replacement of dataset

Placeholder for termination of dataset

C.11.3.3 New Editions, Re-Issues and Updates

When a feature pointing to a text, picture or application file is deleted or updated so that it no longer references the file, the ECDIS software should check to see whether any other feature referenced the same file, before that file is deleted.

NOTE FROM TSMAD25: (NO)Currently says that **The issue date must be greater than the previous issue date of the data set**. If this goes for updates as well I would like to allow for the issue date of an update to be the same as the previous update. We sometimes have to make more than one update to a dataset on the same day, this could be just for technical reasons or to fulfil the requirement in clause 4.5.2.1 regarding size on update files.

C.11.4 Support Files

Place holder for replacement of support files

Place holder for termination of support files.

ANNEX D – Feature Catalogue

ANNEX F – Portrayal Catalogue