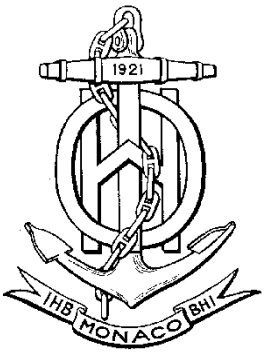
TSMAD22/DIPWG3-11.3B

INTERNATIONAL HYDROGRAPHIC ORGANIZATION



IHO ELECTRONIC NAVIGATIONAL CHART PRODUCT SPECIFICATION

Comment [JLP1]: FR: Change title from IHO Geospatial Standard to ENC product Specifcation

Draft 0.0.6 – February 2011

Special Publication No. 101
Electronic Navigational Chart Product Specification

Published by the
International Hydrographic Bureau
MONACO

Version Number	Date	Author	Purpose
0.1	May 2009	J. Powell	Initial Draft
0.2	June 2010	J. Powell	Merged all the phases back into a single document
0.0.3	July 2010	J. Powell	Added comments from AHO
0.0.4	September	J. Powell	Revised based on FG discussions
0.0.5	December 2010	J. Powell	Revised based on TSMAD 21
0.0.6	February 2011	J.Powell	Revised based on comments to phase 1 from 2J, FR, AU.

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1 Overview

1.1 Introduction

1.2 References

1.3 Terms, definitions and abbreviations

Comment [JLP2]: FR: As in the Encoding Guide, we should have a paragraph "Use of language" which explain the requirement levels for words must, should and may.

1.3.1 Terms and Definitions

Data set
an identifiable collection of data [ISO 19115].

ENC
The latest version of official data carried by a vessel for the intended voyage.

ENC Product Specification
The set of specifications intended to enable Hydrographic Offices to produce a consistent ENC, and manufacturers to use that data efficiently in an ECDIS that satisfies the IMO Performance Standards for ECDIS. An ENC must be produced in accordance with the rules defined in this Specification and must be encoded using the rules described in the Data Capture and Classification Guide.

Comment [JLP3]: FR: Review this definition.

point
0-dimensional **geometric primitive**, representing a position

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

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

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

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

1.3.2 Abbreviations

IHO	International Hydrographic Organization
ENC	Electronic Navigational Chart
SENC	System Electronic Navigational Chart
IMO	International Maritime Organization
ISO	International Organization for Standardization
ECDIS	Electronic Chart Display Information System
SOLAS	Safety of Life at Sea
CRS	Coordinate Reference System

EPSG European Petroleum Survey Group

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 function is for use within an Electronic Chart Display and Information Systems (ECDIS) to meet International Maritime Organisation (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: This Product Specification is a complete description of all the appropriate features, attributes and their relationships necessary to define an ENC data product. The precise content is documented within the Feature Catalogue and the relationships defined in the Application Schema. Details of how these features should be symbolised are contained in the associated Portrayal Catalogue.

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 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.

Title: The International Hydrographic Organization Electronic Navigational Chart Product Specification

S-100 Version: 1.0.0

S-101 Version: 0.1.0

Date: June 25, 2010

Language: English

Classification: Unclassified

Contact: International Hydrographic Bureau (IHB)

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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 shall be made available via the IHO web site. Maintenance of the Product Specification shall 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* shall 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.

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

1.5.1.4 Clarification

Clarifications are non-substantive changes to S-101. Typically, clarifications: remove ambiguity; correct grammatical and spelling errors; amend or update cross references; insert improved graphics in spelling, punctuation and grammar. A clarification must not cause any substantive semantic change to S-101.

1.5.1.5 Version Numbers

The associated version control numbering to identify changes (n) to S-101 shall 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 will be identifiable by the discovery metadata that supports it.

Title: Electronic Navigational Chart

Alternate Title: ENC

Abstract: When an S-101 ENC is produced it must be in accordance with the rules defined in the S-101 Product Specification. S-101 details specifications intended 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

Geographic Description: Areas specific to marine navigation.

Spatial Resolution: The scales for ENC have been aligned with the standard RADAR ranges and are as follows:

Standard RADAR Ranges	Scale
	>1:3,000,000
200 NM	1:3,000,000
96 NM	1:1,500,000
48 NM	1:700,000
24NM	1:350,000
12 NM	1:180,000
6 NM	1:90,000

3 NM	1:45,000
1.5 NM	1:22,000
0.75 NM	1:12,000
0.5 NM	1:8,000
0.25 NM	1:4,000
	<=1:2,000

Table 1: Standard Display Scales

Comment [JLP4]: FR: In the lower row , it should be ≤ **1:4,000**

ED NOTE: In South Africa it was agreed to add one more level that went beyond S-65

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

Comment [JLP5]: FR: Change "… Display Systems" by " … Display and Information Systems"

Language: English

Comment [JLP6]: FR: English and other languages

Classification: Unclassified

Comment [JLP7]: FR: Could be protected

ED NOTE: Would there ever be a circumstance it would be classified

Point of Contact: Producing Hydrographic Office

Comment [JLP8]: FR: The producer might not be a HO

ED NOTE: It could be a government authorized – suggest using the IMO terminology regarding who produces an official chart

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

4 Data Content and structure

Comment [JLP9]: NOTE: some of these concepts will get implemented in later phases of S-101.

4.1 Introduction

An S-101 ENC is a feature-based product. This section contains the product Application Schema expressed in UML and an associated Feature Catalogue. The Feature Catalogue provides a full description of each feature type including its attributes, attribute values and relationships in the data product.

4.2 Application Schema

S-101 is based on the General Feature Model (GFM) from S-100. The GFM is the conceptual model and the implementation is defined in the Feature Catalogue.

Comment [r10]: Holger's modified GFM will need to go in here

Comment [JLP11]: 2J: Wrong Model, Replace with a new model TBD.

Formatted: Keep with next

Figure 1 - S-101 General Feature Model

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 will be available in an XML document which conforms to the S-100 XML Feature Catalogue Schema. The S-101 Feature Catalogue is available from the IHO website.

4.3.2 Feature Types

4.3.2.1 Geographic

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

4.3.2.2 Meta (S-57 PS 3.4)

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.

The maximum use must be made of meta features to reduce meta attribution on individual features.

The Meta feature **DataCoverage** provides an exhaustive, non-overlapping coverage of the entire cell.

4.3.2.3 Aggregated (S-57 PS 3.9)

An Aggregated Feature Type is a feature which is made up of component features. See clause ?? on Feature Associations.

EXAMPLE 1 Traffic Separation Scheme feature of type aggregation may consist of Traffic Separation Lane Parts, Precautionary Area, etc. (Feature Association is a Composition, see clause 4.3.3.3)

EXAMPLE 2 A range of type aggregation is composed of a Navigation Line, front beacon, rear beacon and recommended track. (Feature Association is an Aggregation, see clause 4.3.3.2)

4.3.2.4 Theme

Theme features are a special kind of collection. They do not define a feature itself but group other features together. The reasons for the grouping are mostly thematic, other reasons are possible. Each feature may belong to more than one theme. Themes are therefore not mutually exclusive. Since the kind of association from a theme feature to its members (and vice versa) is not variable, the encoding of this type of association is different from the other feature associations. Themes are encoded using the "Theme Association Field" [THAS].

Comment [r12]: Action TR to produce UML Diagrams

Comment [JLP13]: AU: Is this correct syntax? This example "consists of" a bunch of features to form a "composition", while example 2 is "composed of" a bunch of features to form an "aggregation". Why isn't the composition "composed of"??

Comment [JLP14]: TSMAD 21: Still have yet to find an appropriate use case for Themes. This may be removed in the future

4.3.2.4.1 Skin of the Earth Theme (S-57 PS 3.10.1)

Themes are normally defined in the Feature Catalogue however in this case there are constraints which have to be observed. Skin of the Earth features are a set of geo features of geometric type area that must not overlap each other and form a continuous surface named “Skin of the Earth”. The features listed below represent the only allowable features in this theme.

DepthArea (**DEPARE**)

DredgedArea (**DRGARE**)

LandArea (**LNDARE**)

UnsurveyedArea (**UNSARE**)

Each area covered by a meta feature Data**Coverage** with categoryOfCoverage = 1 must be totally covered by a set of geo features of type area from the above list that do not overlap each other (the Skin of the Earth). The geometry of coincident boundaries between Skin of the Earth features must not be duplicated.

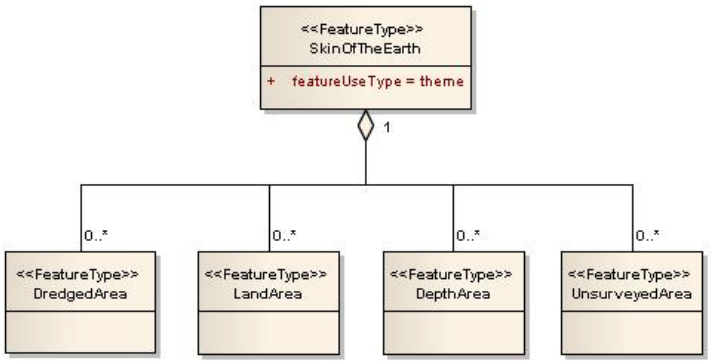


Figure 2 - Skin of the Earth Theme

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 three types of defined feature relationships in S-101 as described in the following sub clauses.

4.3.3.1 Association

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

EXAMPLE In an association a wreck is marked by a cardinal buoy and the cardinal buoy marks the wreck.

Comment [JLP15]: Need new example to go with the UML.

2J: Replace with model from Tom R. And modify text to fit new example.

FR: A UML diagram of wreck – buoy could be more adequate

ED NOTE: Model has been updated. Need a better example in words

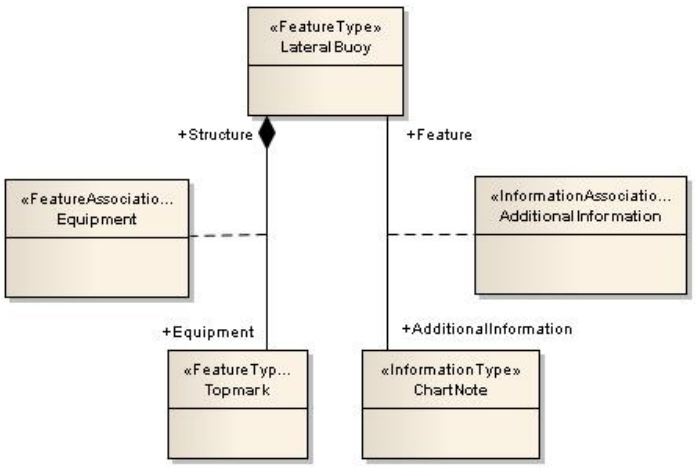


Figure 3 - Association

4.3.3.2 Aggregation

An aggregation is a relationship between two feature types, in which one of the feature types plays the role of a container and the others play the role of containee.

EXAMPLE Navigation Line, recommended track, rear and front beacon are a member of a range group.

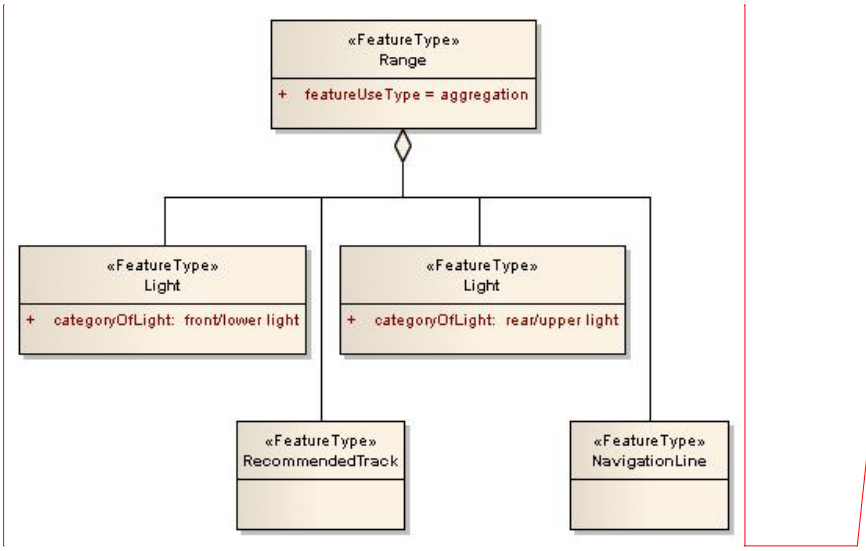


Figure 4 - Aggregation

Comment [JLP16]: 2J: Replace model

ED NOTE: Model is replaced

4.3.3.3 Composition

A composition is a strong aggregation. In a composition, if a container object is deleted then all of its containee objects are deleted as well.

EXAMPLE If a feature type of TSS is deleted, then all of its component feature types that make up the TSS are deleted.

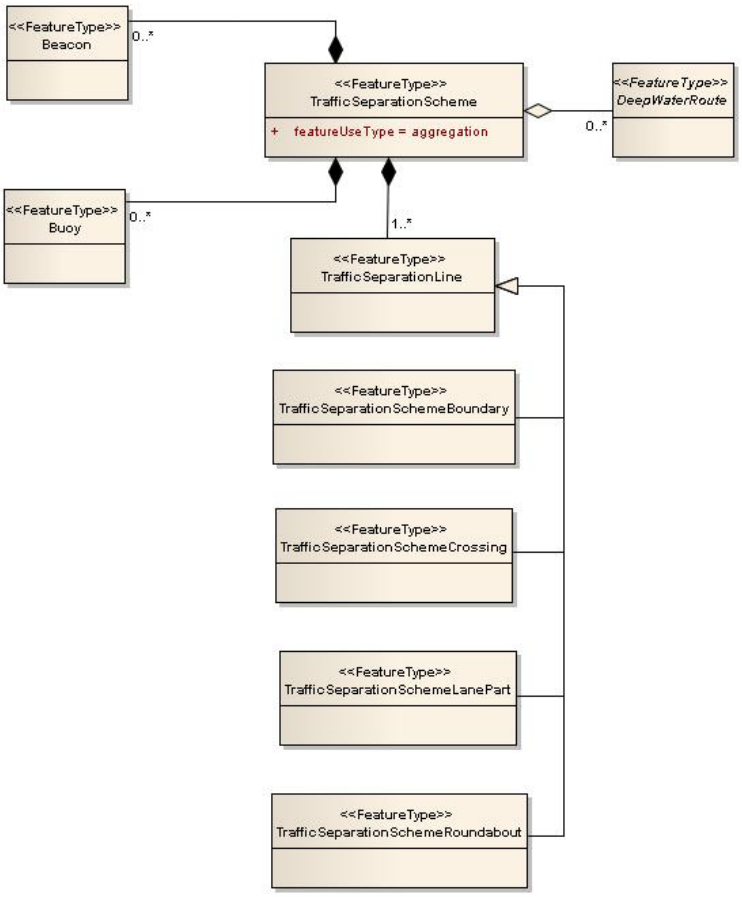


Figure 5 - Composition

4.3.4 Information Types

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

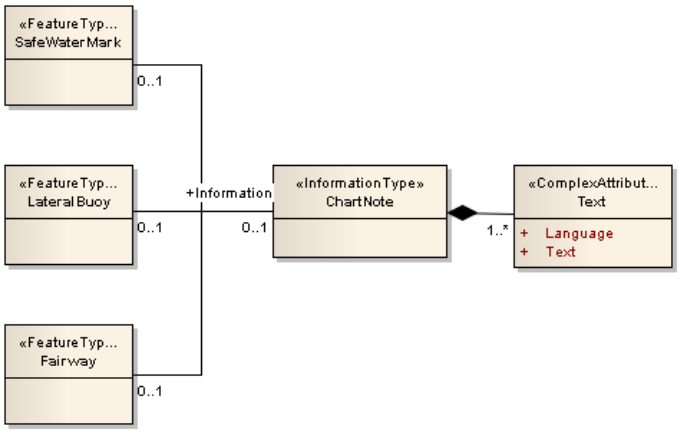


Figure 6 - Information Type

4.3.5 Attributes

4.3.5.1 Numeric Attribute Values (S-57 PS 3.5.4)

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

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.

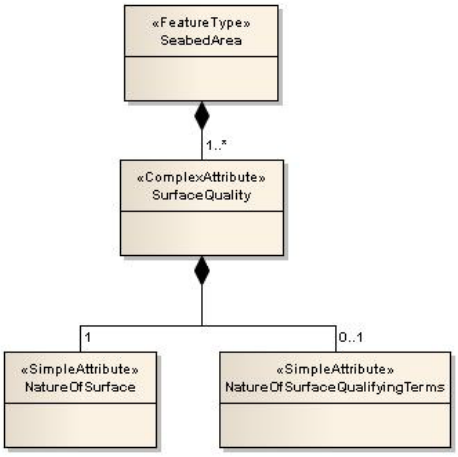


Figure 7 - Complex Attribute

4.3.5.3 Text Attribute Values (S-57 PS 3.5.5)

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

4.3.5.3.1 Text Placement

The text encoded in the object name attribute of a feature can be given an anchor point that specifies the placement of the text within an ECDIS. When a feature is encoded with an object name and the compiler wishes the text to appear in a specific place a text placement complex attribute must be encoded detailing the true bearing in degrees and the distance value from the feature.

Comment [JLP17]: Phase 3: AU comment: Would this work? If we are going to specify a distance, this should probably be the distance in mm at the viewing scale to make the text "appear" to be in the same position in relation to the feature at any display scale. Is this technically possible? How would this work for line and area features?

4.3.5.4 Mandatory Attribute Values (S-57 PS 3.5.2)

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 B – Data Classification and Encoding Guide.

4.3.5.5 Missing Attribute Values (S-57 PS 3.5.1)

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.

4.4 Feature Object Identifier (S-57 PS 3.1)

Each real world feature and instances of information type within an ENC must have a unique universal Feature Object Identifier.

For ENC the Feature Object Identifier may be used to identify multiple instances of the same real world feature within a single cell or across multiple cells. For example, the same feature may appear in different optimum display scales, or a feature may be split by the cell structure. In these circumstances each instance of this feature should have the same identifier.

Feature Object Identifier's must not be reused, even when a feature has been deleted.

4.5 Scale Independent and Scale Dependent Cells

ENC producers can make the decision to partition a set of navigational data into two separate cells based on the scale dependent and scale independent geometric properties of features. This concept splits a collection of data into two groups. The primary advantage of this structure is that receiving systems only hold the scale independent features once, instead of multiple occurrences at different display scales. This in turn effectively reduces the file size of an ENC exchange set and increases the speed at which updates can be applied to cells.

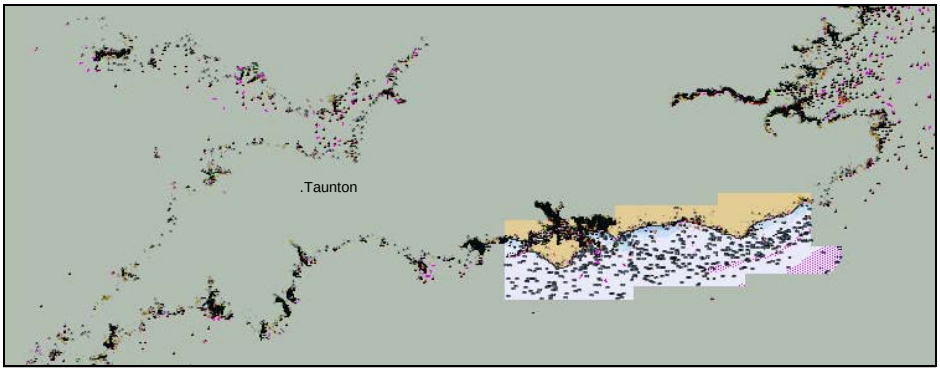


Figure ?? A scale independent cell overlaid with three scale dependant cells.

4.5.1 Scale Independent Dataset

There can be more than one scale independent cell contained within an exchange set. To view scale independent data in a receiving system there must be an accompanying cell containing the scale dependent data for that area. A scale independent cell will not contain any meta features. A nation responsible for the population of a scale independent data set will be obligated to produce scale dependent data sets of the same area. The display scale of the cell must be set to 0. All features within a scale independent cell must have the attribute, scale minimum and (scale max?) encoded.

4.5.1.1 Scale Independent Dataset Content

Listed in Table 2 are the allowable features and their geometric primitive types which make up the content of a scale independent cell.

ACROYNM	NAMES	GEOMETRIC TYPE	UKHO FODB	NOAA Scale Independent Features
BCNCAR	Beacon, cardinal	P	P	P
BCNISD	Beacon, isolated danger	P	P	P
BCNLAT	Beacon, lateral	P	P	P
BCNSAW	Beacon, safe water	P	P	P
BCNSPP	Beacon, special purpose/general	P	P	P
BUISGL	Building single	P, A	P	
BOYCAR	Buoy, cardinal	P	P	P
BOYISD	Buoy, isolated danger	P	P	P
BOYLAT	Buoy, lateral	P	P	P
BOYSAW	Buoy, safe water	P	P	P
BOYSPP	Buoy, special purpose	P	P	P
BOYINB	Buoy, installation	P	P	P
CGUSTA	Coastguard station	P	P	
CHKPNT	Check point	P		
CTRPNT	Control Point	P		
DAYMAR	Day mark	P	P	P
DISMAR	Distance mark	P		
FOGSIG	Fog signal	P	P	P
DWRTCL	Deep water route centreline	L		
DWRTPT	Deep water route part	A		
FORSTC	Fortified structure	P	P	
LNDMRK	Landmark	P	P	
LIGHTS	Light	P	P	P

LITFLT	Light Float	P	P	P
LITVES	Light vessel	P	P	P
MORFAC	Mooring/Warping facility	P	P	
PILPNT	Pile	P		
PILBOP	Pilot boarding place	P		
OBSTRN	Obstruction	P		
OFSPLF	Offshore platform	P	P	
OSPARE	Offshore production area	A		
PILBOP	Pilot boarding place	P, A		
PRCARE	Precautionary area	P, A		
PYLONS	Pylon/bridge support	P	P	
RADRFL	Radar reflector	P		P
RADSTA	Radar station	P	P	P
RTPBCN	Radar transponder beacon	P	P	P
RDOCAL	Radio calling-in point	P	P	
RDOSTA	Radio station	P	P	P
RECTRC	Recommended track	L		
RSCSTA	Rescue station	P	P	
SISTAT	Signal station, traffic	P	P	
SISTAW	Signal station, warning	P	P	
SILTNK	Silo/tank	P	P	
TOPMAR	Top mark	P	P	P
TSELNE	Traffic separation line	L		
TSEZNE	Traffic separation zone	A		
TSSBND	Traffic separation scheme boundary	L		
TSSCRS	Traffic separation scheme crossing	A		
TSSLPT	Traffic separation scheme lane part	A		

TSSRON	Traffic separation scheme roundabout	A		
TWRTPT	Two-way route part	A		
UWTROC	Underwater/awash rock	P		
WRECKS	Wreck	P, A		

4.5.2 Scale Dependent Datasets

Scale dependent datasets will not contain any of the feature classes present in the scale independent list. Scale dependent datasets with the same display scale may overlap. However, data within must not overlap. Therefore, in the area of overlap only one dataset may contain data.

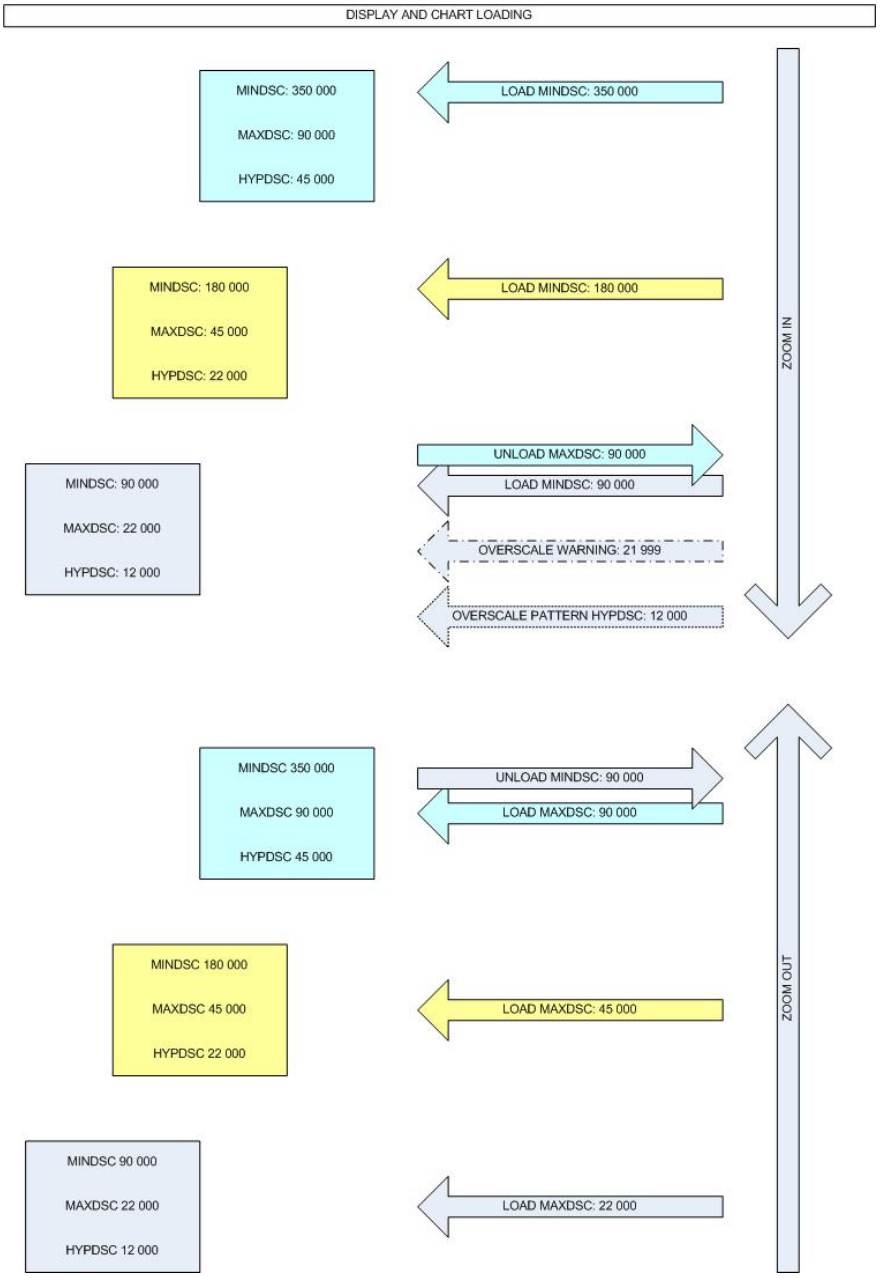
4.6 Display

Comment [JLP18]: OUTSTANDING ACTIONS:

1. Need to define MINDSC,MAXDSC,HYPDSC
2. Need to define what goes in the PS
3. Need to define what goes in the DCCG
4. Need to provide implementation guidelines

Display scale will be the optimum viewing scale of the data within the dataset. In addition to the optimum display scale the producer will encode the maximum and minimum display scales an ENC can be viewed at.

It will not be possible for a user to zoom past a cells display scale maximum or minimum values. In the event a user wishes to zoom into the product see the detail of the data in greater clarity a larger display scale cell should be loaded. Conversely if the user wished to get an overview of an area and zooms out a smaller display scale chart will load when the minimum value is reached. If there is no smaller or larger scale information available systems will not allow users to unload the current cell or zoom past the display scale max and min values. Producers of the ENC data have made the informed decision that data viewed beyond the max and min display scales would be degraded to such an extent that the product would become unsafe.


DISPLAY AND CHART LOADING
MINDSC: 350 000
MAXDSC: 90 000
HYPDSC: 45 000
LOAD MINDSC: 350 000
ZOOM IN
MINDSC: 180 000
MAXDSC: 45 000
HYPDSC: 22 000
LOAD MINDSC: 180 000
MINDSC: 90 000
MAXDSC: 22 000
HYPDSC: 12 000
UNLOAD MAXDSC: 90 000
LOAD MINDSC: 90 000
OVERSCALE WARNING: 21 999
OVERSCALE PATTERN HYPDSC: 12 000
MINDSC 350 000
MAXDSC 90 000
HYPDSC 45 000
UNLOAD MINDSC: 90 000
LOAD MAXDSC: 90 000
ZOOM OUT
MINDSC 180 000
MAXDSC 45 000
HYPDSC 22 000
LOAD MAXDSC: 45 000
MINDSC 90 000
MAXDSC 22 000
HYPDSC 12 000
LOAD MAXDSC: 22 000

4.7 Geometry (S-57 PS 2.3 and 3.8)

Comment [JLP19]: BG to constrain

Formatted: Keep with next

Figure 8 - Geometry

S-100 Level 3a Geometry

The underlying geometry of an ENC is constrained to S-100 level 3a which supports 0, 1 and 2 dimensional objects (points, curves and surfaces).

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.
- 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 another internal boundary or the external boundary tangentially (i.e. at one point).
- 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.

Comment [JLP20]: FR: See SHOM comments, dated 29/01/07
"S-100 for comments and editorial observations – 1D/2D Spatial Component"

Propose to Add :
A curve must not be self tangent.

Comment [JLP21]: AU: Can they touch without intersecting. I am thinking of e.g. a railway or road loop (a problem with S-57). This is probably more related to S-100?

Comment [JLP22]: AU: Insert the following:

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

Comment [JLP23]: FR: There is no clear way to mask a curve in the data as it was in S-57 3.8

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

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.

5 Coordinate Reference Systems (CRS)

5.1 Introduction (S-57 PS 4.1)

Due to the nature of hydrography 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 a 2D geodetic CRS (WGS84) and a vertical CRS.

5.2 Horizontal Coordinate Reference System (S-57 PS 4.1)

For ENC the geodetic datum of the horizontal CRS must be EPSG:4326. No projection is to be used. If the CRS EPSG:4326 is not defined in the encoding by referencing then it must be fully defined, encoding all parameters and referenced to a geodetic Coordinate Reference System which incorporates an ellipsoidal coordinate system with axes graduated in degrees.

Comment [JLP24]: 2J: "If the CRS EPSG:4326 is not defined in the encoding by referencing then it must be fully defined, encoding all parameters and referenced to a geodetic Coordinate Reference System which incorporates an ellipsoidal coordinate system with axes graduated in degrees."
Defined where?

Include better reference to what part of the encoding would contain the CRS definition.

FR: EPSG is for European Petroleum Survey Group. It cannot be used as a reference for an international standard. Why not use WGS 84 or ITRS coordinate reference systems.

5.3 Vertical CRS for Soundings (S-57 PS 4.2)

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

Comment [JLP25]: FR: Amend "meters" for "metres" to be consistent in the whole document (see A1.5.3.3)

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

6 Data Quality (S-57 UOC)

Comment [YUN26]: ACTION: Look at S-100 data quality section. Write something for Barrie to take to DQWG regarding this section , what should go into this section etc...

Comment [r27]: Think we're still waiting on DQWG I had a look at ISO 19157 but its too high level, we may need to provide a draft to DQWG to get anywhere here

6.1 Introduction

Data quality comprises the following:
- source of data;
- accuracy of data;
- up-to-datedness of data.

Data quality is considered to be meta information. As such, it can be encoded at three different levels.

Data quality information is considered to be application specific. Therefore, rules for encoding data quality must be defined by the relevant Product Specification.

6.2 Quality, Reliability and Accuracy of Bathymetric Data

Information about quality, reliability and accuracy of bathymetric data is given using:
- the meta feature **QualityOfData** for an assessment of the quality of bathymetric data,
- the meta feature **SurveyReliability** for additional information about the survey,
- the attributes QUASOU, SOUACC and TECSOU on groups of soundings or individual features,
- the attributes POSACC and QUAPOS on the spatial features.

For the mariner, **QualityOfData** provides the most useful information. Therefore, the use of **QualityOfData** is mandatory for areas containing depth data or bathymetry.

More detailed information about a survey may be given using **SurveyReliability**. For example, in incompletely surveyed areas, lines of passage soundings may be indicated as such using a linear **SurveyReliability** feature. This information is more difficult for the mariner to interpret. Therefore, the use of **SurveyReliability** is optional.

For individual features (wrecks, obstructions etc), or small groups of soundings, QUASOU, SOUACC and TECSOU may be used to provide additional information about quality and accuracy.

6.2.1 Quality of bathymetric data

The meta feature **QualityOfData** defines areas within which uniform assessment exists for the quality of bathymetric data, and must be used to provide an assessment of the overall quality of bathymetric data to the mariner. Areas of a cell containing depth data or bathymetry must be covered by one or more **QualityOfData**, which must not overlap.

6.2.2 Survey reliability

The survey reliability may be encoded using the meta feature **SurveyReliability**.

6.2.3 Quality of sounding

If it is required to encode the quality of sounding, it must be done using the attribute QUASOU on either the meta feature **SurveyReliability** or on individual geo features (e.g. **Sounding**).

The quality of sounding must not be encoded using QUASOU on the depth geo feature, unless it is different to the value of QUASOU populated on an encoded **SurveyReliability** feature covering the geo feature.

6.2.4 Sounding accuracy

Sounding accuracy is encoded using the attribute CATZOC on the meta feature **QualityOfData**. If it is required to encode additional sounding accuracy information, it must be done using the attribute SOUACC on either the meta feature **QualityOfData** or on individual geo features (e.g. **Sounding**).

The accuracy of sounding must not be encoded using SOUACC on the depth geo feature, unless it is different to the value of SOUACC encoded on the covering **QualityOfData** feature.

6.2.5 Technique of sounding measurement

If it is required to encode the technique of sounding measurement, it must be done using the attribute TECSOU on either the meta feature **QualityOfData** or on individual geo features (e.g. **Sounding**).

The technique of sounding measurement must not be encoded using TECSOU on the depth geo feature, unless it is different to the value of TECSOU encoded on the covering **AccuracyOfPosition** feature.

6.3 Accuracy of non-bathymetric data

6.3.1 Quality of positions

The meta feature **AccuracyOfPosition** may be used to provide an overall accuracy of position for all non-bathymetric features. It must not be used to provide the accuracy of bathymetric information.

The attributes QUAPOS and POSACC may be applied to any spatial feature, in order to qualify the location of a feature.

QUAPOS and POSACC must not be applied to the referenced spatial feature of any geo feature if they are identical to the QUAPOS and POSACC values of the underlying meta feature.

QUAPOS gives qualitative information, whereas POSACC gives quantitative information. POSACC on the **AccuracyOfPosition** applies to non bathymetric data situated within the area, while QUAPOS or POSACC on the associated spatial features, qualifies the location of the **AccuracyOfPosition** feature itself. Meta features **AccuracyOfPosition** and **QualityOfData** should not overlap.

6.3.2 Horizontal accuracy

If it is required to encode the accuracy of a horizontal clearance (attribute HORCLR), it must be done using the attribute HORACC.

HORACC applies only to HORCLR. There is no attribute to express the accuracy of the attributes HORLEN and HORWID.

6.3.3 Vertical accuracy

If it is required to encode the accuracy of a vertical clearance (attributes VERCLR, VERCOP, VERCSA, VERCCL), it must be done using the attribute VERACC.

If several vertical clearances are given for one feature, the accuracy given must be that of the least accurate.

6.3.4 Source of bathymetric data

Details of the source surveys used in compilation may be encoded using the meta feature **SurveyReliability**.

6.3.5 Source of other data

The source of non-bathymetric information should be encoded using both the attributes SORINF and SORDAT on the individual features, but only if this information is considered to be useful to the mariner.

7 Data Capture and Classification

7.1 Introduction

The S-101 ENC Data Classification and Encoding Guide (DCEG) provides the information to map real world features into the dataset. This Guide is located in Annex B. S-101 datasets shall conform to the ENC DCEG.

8 Maintenance

Maintenance and Update Frequency:

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

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 in the appropriate metadata field.

Production Process:

Data Producers should follow their established production processes for maintaining and updating datasets. Datasets shall be checked against S-58 (equivalent). Data is produced against the DCEG, checked against S-58 and encapsulated in 8211.

9 Portrayal

9.1 Introduction

The display of features contained in an S-101 dataset is determined by the symbology and portrayal rules contained in the S-101 Portrayal Catalogue.

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

Comment [YUN28]: Need phase in dates or approach for new catalogue delivery.

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

10 Data Product format (encoding)

10.1 Introduction

This clause specifies the encoding for S-101 datasets. See Annex A for a complete description of the data records, fields and subfields defined in the encoding.

Format Name: ISO/IEC 8211

Version: 1.0.0

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 (S-57 PS 4.4)

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.

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

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

Comment [JLP29]: 2J: Missing a 0

10.1.2 Encoding of Depths (S-57 PS 4.4)

Depths are converted from decimal meters to integers by means of the CMFZ. This product limits the resolution to twoone decimal place and therefore the CMFZ must be set to 100.

Comment [JLP30]: 2J and FR and AU– change from one to two

11 Data Product Delivery (S-57 PS 5.8? and 2.2)

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.

11.2 Exchange Set

An exchange set is a grouping of data sets in a logical, consistent and self-contained collection to support the interchange of geospatial data and meta data. It is comprised of at least one data set (i.e a collection of features) and one exchange catalogue. This is the minimum number of entities that can be encapsulated in an exchange set. An exchange set may also contain any number of 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 meta data for each data set and references to any support files.

– these are files of supplementary information which are linked to by the TXTDSC/PICREP (?) fields within the cells.

An exchange set is encapsulated into a form suitable for transmission either on hard or soft media 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.

This product specification defines a single example encoding for ENC exchange sets which is described in the next section. This encoding provides a hard-media / file based encoding for an exchange set with no encrypted or compressed contents and an additional file based cyclic redundancy check. It is not intended that this encoding is used for commercial distribution of ENC data as it contains no copy protection mechanisms or data authentication means. A complete encoding suitable for commercial distribution will be published in IHO XX-YY..

With all encodings it is paramount that data is only transformed and not changed. The acid test for an encodings consistency is the ability to extract individual feature information and recalculation of the

features CRC value as defined in this standard. If an encoding can replicate the features CRC for arbitrary ENC data then the data has only been transformed (i.e reformatted) and not changed.

The S-101 Product Specification defines an encoding which can be used as a default for transmission of data between parties.

The encoding encapsulates exchange set elements as follows:

- ENC datasets – ISO 8211 encoding of features/attributes and their associated geometry and metadata. Defined further in XXXX
- Exchange Catalogue – the XML encoded representation of exchange set catalogue features [discovery metadata]. Includes an additional file level CRC check per dataset.
- Useful information about the ENC dataset. This is contained within a README.TXT file.
- Supplementary files – These are contained within the exchange set as files and the map from the name included within the cell and the physical location on the media is defined within the Exchange Catalogue.

11.3 Dataset

11.3.1 Datasets (S-57 PS 5.5)

Three~~Two~~ kinds of ENC dataset may be produced and contained within an exchange set:

Comment [JLP31]: FR: Amend the first word "Two" for "Three kinds of ENC datasets…."

- Update: Changing some information in an existing data set.
- re-issue of a data set : 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.
- 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 has previously been produced for this area and at the same optimum display scale

Datasets shall not exceed 10MB.

Comment [JLP32]: FR: The size limit for ERs should be added (From EUWG decision).

Wait for EUWG study

FR: EB31 - The following rule should be added :
An ENC update data set must not change the limit of data coverage for the base ENC cell. Where the limit of data coverage for a base ENC cell is to be changed, this should be done by issuing a new edition of the cell.

A Data Set is a grouping of features, attributes, geometry and metadata which comprises a specific coverage. A data set can contain more than one DataCoverage. The data boundary is defined by the extent of the DataCoverage features.

Features with the geometric properties of point or line coincident with the border of two data sets with the same display scale must be part of only one data set.

When a feature extends across data sets at the same optimum display scale its geometry must be split at the data set boundaries and its complete attribute description must be repeated in each data set.

In order to facilitate the efficient processing of ENC data the geographic coverage of a given optimum display scale must be split into data sets. Each data set must be contained in a physically separate, uniquely identified file on the transfer medium.

Data Sets within the same spatial resolution (Scale) may overlap. However, data within the data set must not overlap. Therefore, in the area of overlap only one data set may contain data, all other cells must have a meta feature Data**Coverage** with categoryOfCoverage = 2 covering the overlap area. This rule applies even if several producers are involved. There must be no overlapping data of the same scale, except at the agreed adjoining national data limits, where, if it is difficult to achieve a perfect join, a 5 meter overlapping buffer zone may be used.

Data Sets may cross the 180° meridian.

11.3.2 Dataset file naming (S-57 PS 5.6.1)

README file
README.TXT is the mandatory name for this file.

ENC Dataset files
ENC dataset files are named according to the specifications given below:

CCXXXXXXXX.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 – new editions use 000, updates start at 001 and increment until a limit of 999.

Comment [JLP33]: AU: Are these optional i.e. do you have to use all 7 or if you want to only use 5 of them? I recall this was discussed at TSMAD21 and I thought the outcome was that they are optional.

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 and Updates(S-57 PS 5.7)

This section describes how S-101 defines updating methodologies for ENC datasets. 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. The first update cell 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. The new edition must have update number 0.

Re-issue number A re-issue of a data set must have the update number of the last update applied to the dataset. In the case of an update dataset the file extension is the same as the update number.

update comment comment for describing the change introduced by an update.

issue date date up to which the data producer has incorporated all applicable changes.

In order to cancel a data set, an update cell file is created for which the edition number must be set to 0. This message is only used to cancel a base cell file. Where a cell is cancelled and its name is re used at a later date, the issue date must be greater than the issue date of the cancelled cell.

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.

Comment [JLP34]: AU: Is this relevant to the PS, or should it be in the ECDIS PS and 61174?

An exchange set may contain base cell files and update cell files for the same cells. Under these circumstances the update cell files must follow on in the correct sequential order from the last update applied to the base cell 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)***

File Types	**Extensions**	
Text	TXT	
	HTM	
	XML	
Picture	TIFF	Baseline TIFF 6.0

11.4.1 Support File Naming

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

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

CCXXXXXXXX.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.

11.4.2 Support File Management

Placeholder until this gets fleshed out.

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 (S-57 PS 5.9)

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 Cyclic Redundancy Check (CRC). File integrity checks are based on the CRC-32 algorithm (a 32 bit Cyclic Redundancy Check algorithm) as defined in ANSI/IEEE Standard 802.3, the reference for which is given in clause 1.2.

11.6.2 Implementation

The checksums for each data set are held in the "CRC" [CRCS] subfield of the "Catalogue Directory" [CATD] field. They allow the integrity of each file in the exchange set to be checked on receipt. The CRC value computed on the received file must the same as the CRC value transmitted.

The CRC values are recorded in ASCII as a hexadecimal number.

Comment [JLP35]: NEEDS REVIEW as it is stored in the Discovery Metadata.

FR: Add "be" : The CRC value computed on the received file must **be** the same …

11.6.3 Processing

Encoding is defined by the following generating polynomial:

$$G(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^{8} + x^{7} + x^{5} + x^{4} + x^{2} + x + 1$$

Processing is applied to relevant files as they appear in the exchange set.

The CRC value of the file is defined by the following process:
1. The first 32 bits of the data are complemented.
2. The n bits of the data are then considered to be the coefficients of a polynomial M(x) of degree n-1.
3. M(x) is multiplied by x^{32} and divided by G(x), producing a remainder R(x) of degree <31.
4. The coefficients of R(x) are considered to be a 32-bit sequence.
5. The bit sequence is complemented and the result is the CRC.

The hexadecimal format of CRCs are converted to ASCII characters and stored in the "Catalogue Directory" [CATD] field.

An example of coding in C language is given in Annex.

12 Metadata

12.1 Introduction

This clause defines the mandatory and optional metadata needed for S-101. In some cases the metadata may also support national language. If this is the case it is noted in the Remarks column.

12.1.1 Exchange Set Metadata

12.1.2 Dataset Metadata

Name	Cardinality	Value	Type	Remarks
DataSetDiscoveryMeta data	-		-	-
metadataFileIdentifier	1		CharacterString	
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	Full path from the exchange set root directory
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	{1} to {2}	CharacterString	1. Encrypted 2. Unencrypted
purpose	1	{1} to {5}	CharacterString	1. New Dataset 2. New Edition 3. Update 4. Re-issue 5.Cancellation
specificUsage	1	{1} to {3}	Integer	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 • route planning or any combination of the above. 3.Overview – A dataset containing

Comment [JLP36]: Need to review the type against 19115 and S-100

Name	Cardinality	Value	Type	Remarks
				data required: • for Ocean Crossing • route planning
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.
issueDate	1		Date	Date on which the data was made available by the data producer.
productSpecification	1	S-101 version 0.0.1	S-100_ ProductSpecification	This must be encoded as S-101
producingAgency	1		CI_ResponsibleParty	Agency responsible for producing the data.
minimumDisplayScale	1	{1} to {13}	double	Display scale must be one of the 13 predefined scales detailed in Table 1.
horizontalDatum	1	WGS84	CharacterString	EPSG:4326
verticalDatum	1	{1} to {30}	Integer	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}	Integer	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

Comment [JLP36]: Need to review the type against 19115 and S-100

Comment [JLP37]: Need to deal with metadata for hyperdisplay, minimum display and maximum display

Name	Cardinality	Value	Type	Remarks
				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)
dataType	1	ISO 8211 BINARY	S-100_DataFormat	
otherDataTypeDescription	0..1		CharacterString	
boundingBox	1		EX_GeographicBoundingBox	
boundingPolygon	1..*		EX_BoundingPolygon	
comment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
cyclicRedundancyCheck	1		CharacterString NonNegativeInteger	
layerId	1..*	{1} to {3}	integer	Identifies the relationship to other layers that are required to view the complete data set. 1. Scale Independent 2. Scale Dependent 3. Complete

Comment [JLP36]: Need to review the type against 19115 and S-100

Comment [YUN38]: SI and SD

12.1.3 Support File Metadata

Name	Cardinality	Value	Type	Remarks
S-101 SupportFileDiscoveryMetadata	-		-	-
fileName	1		CharacterString	
filePath	1		CharacterString	
Purpose	1	{1} to {2}	S-100_SupportFilePurpose	1. Insert - Signifies a new file 2. Deletion - Signifies a deletion of

				a file of that name
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.
issueDate	1		Date	Date on which the data was made available by the data producer.
productSpecification	1		S-100_ProductSpecification	Version of S-101
dataType	1	TXT XML HTM TIFF	S-100_SupportFileFormat	Text files Text files Text files Picture files
Comment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
Crc	1		CharacterString	

12.1.4 Exchange Catalogue File Metadata

The catalogue file is defined in XML schema language and the data set files are encoded as ISO/IEC 8211 data records, fields, and subfields. The Exchange catalogue inherits the dataset discovery metadata and support file discovery metadata.

Name	Cardinality	Value	Type	Remarks
metadataFileIdentifier	1		CharacterString	
metadataPointOfContact	1		CI_ResponsibleParty	
metadataDateStamp	1		Date	
metadataLanguage	1	English	CharacterString	All data sets conforming to S-101 PS must use English language
name	1	catalogue.101	CharacterString	Catalogue filename
abstract	1		CharacterString	Description of what the exchange catalogue contains
productSpecification	1			S-101 Version Number
comment	0..1		CharacterString	Any additional Information NATIONAL LANGUAGE enabled
compressionFlag	1	{1} to {2}	CharacterString	1. Yes 2. No
algorithmMethod	1	{1} to {2}	CharacterString	1. ZIP 2. RAR
sourceMedia	1			
replacedData	1			If a data file is cancelled is it replaced by another data file
dataReplacement	0..1			Cell name

Comment [JLP39]: Everything below needs review by DPSWG.

12.2 Language (S-57 PS 3.11)

The exchange language must be English. Other languages may be used as a supplementary option. In general, this means that when a national language is used in the textual national attributes the English translation must also exist in the textual international attributes. National geographic names can be left in their original national language in the international attributes, or transliterated or transcribed and used in the international attributes.

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

ANNEX A

Data Product format (encoding) (S-57 PS 6)

A1 Introduction

A1.1 Data set files

The order of data in each base or update cell 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).

A1.2 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.

A1.3 Fields

For base cell 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.

A1.4 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 clause ???

Comment [j40]: At present, it is intended that this go in the DCCG, therefore this reference should be to Appendix 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 (RUIN) is always set to insert. When encoding updates it can be set to insert, modify or delete.

A1.5 Base cell structure

```
Base dataset file
   |
   |--<1>- Data Set General Information record
   |   |
   |   |--<1>-DSID (11): 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>-CRID (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 (*4): Information Association field
   |
   |
   |--<0..*>-- Point record
   |   |
   |   |--<1>-PRID (4): Point Record Identifier field
   |      |
   |      |-<0..*>-INAS (*4): Information Association field
   |      |
   |      | alternate coordinate representations
   |      |
   |      *-<1>-C2DI (2): 2-D Integer Coordinate field
   |      |
   |      *-<1>-C3DI (4): 3-D Integer Coordinate field
   |
   |
   |--<0..*>-- Multi Point record
   |   |
   |   |--<1>-MRID (4): Multi Point Record Identifier field
   |      |
```

Comment [r41]: I know this is pending revision by HB but I don’t see the INAS field defined anywhere in the 8211 section despite being in the tree diagram

```
|      |-<0..*>-INAS (*4): Information Association field
|      |
|      | alternate coordinate representations
|      |
|      *-<0..*>-C2DI (*2): 2-D Integer Coordinate field
|      |
|      *-<0..*>-C3DI (*4): 3-D Integer Coordinate field
|
|
|--<0..*>-- Curve record
|   |
|   |--<1>-CRID (4): Curve Record Identifier field
|      |
|      |-<0..*>-INAS (*4): Information Association field
|      |
|      |-<1>-PTAS (*3): Point Association field
|      |
|      |-<1>-SEGH (1): Segment Header field
|          |
|          |-<1..*>-C2DI (*2): 2-D Integer Coordinate field
|
|
|--<0..*>-- Composite Curve record
|   |
|   |--<1>-CCID (4): Composite Curve Record Identifier field
|      |
|      |-<0..*>-INAS (*4): Information Association field
|      |
|      |-<0..*>-CUCO (*3): Curve Component field
|
|
|--<0..*>-- Surface record
|   |
|   |--<1>-SRID (4): Surface Record Identifier field
|      |
|      |-<0..*>-INAS (*4): Information Association field
|      |
|      |-<1..*>-RIAS (*5): Ring Association Field
|
|
|--<0..*>-- Feature Type record
    |
    |--<1>-FRID (5): Feature Type Record Identifier field
       |
       |-<1>-FOID (3): Feature Object Identifier field
       |
       |-<0..*>-ATTR (*5): Attribute field
       |
       |-<0..*>-INAS (*4): Information Association field
       |
       |-<0..*>-SPAS (*6): Spatial Association field
       |
       |-<0..*>-FEAS (*5): Feature Association field
       |
       |-<0..*>-THAS (*3): Theme Association field
       |
       |-<0..*>-MASK (*4): Masked Spatial Type field
```

Field Content

A1.5.1 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	DSLG	"EN"	A()	The (primary) language used in this dataset
Dataset abstract	DSAB	omitted	A()	The abstract of the dataset
Dataset edition	DSED		A()	See clause ??
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

A1.5.2 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

A1.5.3 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.

A1.5.3.1 Information Association field

Field Tag: **INAS**	Field Name: Information Association

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.

Comment [JLP42]: ED NOTE: Need values

Formatted Table

A1.5.3.2 Coordinate Reference System Record Identifier field - CRID

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

A1.5.3.3 Coordinate Reference System Header field - CRSH

Subfield name	Label	Value	Format	Comment
CRS index	CRIX			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()	

A1.5.3.4 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

A1.5.3.5 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()	

A1.5.4 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
Object 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

A1.5.5 2-D Integer Coordinate field – C2DI

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

A1.5.6 3-D Integer Coordinate field– 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)

A1.5.6.1 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

A1.5.6.2 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

A1.5.6.3 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

A1.5.6.4 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

A1.5.6.5 Segment Header field - SEGH

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

A1.5.6.6 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

A1.5.6.7 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

A1.5.6.8 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

A1.5.6.9 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

A1.5.7 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
Object 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

A1.5.8 Feature Object Identifier field - FOID

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

A1.5.9 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 object. 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 object. If the value is 2^{32}-1 it does not apply.
Spatial Association Update Instruction	SAUI	{1}	b11	{1} - Insert

A1.5.10 Feature Association – FEAS

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	ASCD		b12	A valid code for the association
Role Code	RLCD		b12	A valid code for the role
Feature Association Update Instruction	FAUI	{1}	b11	{1} - Insert

A1.5.11 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

A1.5.12 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 Update Instruction	MUIN	{1}	b11	{1} - Insert

A1.6 Update dataset structure

```
Update dataset file
   |
   |--<1>- Data Set General Information record
   |   |
   |   |--<1>-DSID (11): 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 (*4): Information Association field
   |
   |
   |--<0..*>-- Point record
   |   |
   |   |--<1>-PRID (4): Point Record Identifier field
   |      |
   |      |-<0..*>-INAS (*4): Information Association field
   |      |
   |      | alternate coordinate representations
   |      |
   |      *-<1>-C2DI (2): 2-D Integer Coordinate field
   |      |
   |      *-<1>-C3DI (4): 3-D Integer Coordinate field
   |
   |
   |--<0..*>-- Multi Point record
   |   |
   |   |--<1>-MRID (4): Multi Point Record Identifier field
   |      |
   |      |-<0..*>-INAS (*4): Information Association field
   |      |
   |      |-<0..1>-COCC (3): Coordinate Control field
   |      |
   |      | alternate coordinate representations
   |      |
   |      *-<0..*>-C2DI (*2): 2-D Integer Coordinate field
   |      |
   |      *-<0..*>-C3DI (*4): 3-D Integer Coordinate field
```

```
|
|
|--<0..*>-- Curve record
|   |
|   |--<1>-CRID (4): Curve Record Identifier field
|      |
|      |-<0..*>-INAS (*4): 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..*>-C2DI (*2): 2-D Integer Coordinate field
|
|
|--<0..*>-- Composite Curve record
|   |
|   |--<1>-CCID (4): Composite Curve Record Identifier field
|      |
|      |-<0..*>-INAS (*4): 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 (*4): Information Association field
|      |
|      |-<1..*>-RIAS (*5): Ring Association Field
|
|
|--<0..*>-- Feature Type record
    |
    |--<1>-FRID (5): Feature Type Record Identifier field
       |
       |-<1>-FOID (3): Feature Object Identifier field
       |
       |-<0..*>-ATTR (*5): Attribute field
       |
       |-<0..*>-INAS (*4): Information Association field
       |
       |-<0..*>-SPAS (*6): Spatial Association field
       |
       |-<0..*>-FEAS (*5): Feature Association field
       |
       |-<0..*>-THAS (*3): Theme Association field
       |
       |-<0..*>-MASK (*4): Masked Spatial Type field
```

Field Content

A1.6.1 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()	{1} – ER Profile
Dataset file identifier	DSNM		A()	The file name including the extension but excluding any path information
Dataset title	DSTL		A()	The title of the dataset
Dataset reference date	DSRD		A(8)	The reference date of the dataset Format: YYYYMMDD according to ISO 8601
Dataset language	DSLG	"EN"	A()	The (primary) language used in this dataset
Dataset abstract	DSAB	omitted	A()	The abstract of the dataset
Dataset edition	DSED		A()	See clause ??
Dataset topic category	*DSTC	{14}{18}	b11	A set of topic categories

A1.6.2 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

A1.6.3 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.

A1.6.4 Information Association field

Field Tag: **INAS**	Field Name: Information Association

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.

Comment [JLP43]: ED NOTE: Need to add values

A1.6.5 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
Object 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

A1.6.6 2-D Integer Coordinate field – C2DI

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

A1.6.7 3-D Integer Coordinate field– 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)

A1.6.7.1 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

A1.6.7.2 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

A1.6.7.3 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

A1.6.7.4 Curve Record Identifier field - CRID

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

		{3}		{2} - Delete {3} - Modify

A1.6.7.5 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

A1.6.7.6 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

A1.6.7.7 Segment Header field - SEGH

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

A1.6.7.8 Composite Curve Record Identifier field - CCID

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

A1.6.7.9 Curve Component Control field - CRPC

Subfield name	Label	Value	Format	Comment
Curve Component update instruction	CCUI		b11	Record name of the referenced record
Curve Component index	CCIX		b12	Record identifier of the referenced record
Number of Curve Components	NCCO		b12	{1} - Forward {2} - Reverse

A1.6.7.10 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

A1.6.7.11 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

A1.6.7.12 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

A1.6.8 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
Object 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

A1.6.9 Feature Object Identifier field - FOID

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

A1.6.10 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 object. 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 object. If the value is 2^{32}-1 it does not apply.
Spatial Association Update Instruction	SAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

A1.6.11 Feature Association – FEAS

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	ASCD		b12	A valid code for the association
Role Code	RLCD		b12	A valid code for the role
Feature Association Update Instruction	FAUI	{1} or {2}	b11	{1} - Insert {2} - Delete

A1.6.12 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

A1.6.13 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 Update Instruction	MUIN	{1} or {2}	b11	{1} - Insert {2} - Delete

Annex B

Data Classification and Encoding Guide

Annex C – Normative

Business Rules of S-101

Comment [r44]: Who is the audience for this annex OEMs and Production Software Manufacturers. I would like to see an annex specific to each audience as with the DCCG for the compiler a user guide for the user (which may form the basis of training) and a software requirements for S-101 ECDIS for OEMs) The Product Specification and Feature Catalogues should provide all that the PSMs need.

JLP Comment: This will be introduced at the next TSMAD meeting for discussion.

C.1 Overview

C.1.1 Introduction

The purpose of this Normative Annex is to provide the business rules of S-101. This annex will contain various use cases for implementers of this product specification to use as guidance.

C.1.4 S-101 General Data Product Description

C.2 Data product specification metadata

C.3 Specification Scopes

C.4 Data Set Identification

Spatial Resolution: The scales for ENC have been aligned with the standard RADAR ranges and are as follows:

Standard RADAR Ranges	Scale
	>1:3,000,000
200 NM	1:3,000,000
96 NM	1:1,500,000
48 NM	1:700,000
24NM	1:350,000
12 NM	1:180,000
6 NM	1:90,000
3 NM	1:45,000
1.5 NM	1:22,000
0.75 NM	1:12,000
0.5 NM	1:8,000

0.25 NM	1:4,000
	<=1:2,000

Table 1: Standard Display Scales

C.5 Data Content and structure

C.5.1 Introduction

C.5.2 Application Schema

C.4.3 Feature Catalogue

C.4.3.1 Introduction

C.4.3.2 Feature Types

C.4.3.2.1 Geographic

C.4.3.2.2 Meta (S-57 PS 3.4).

C.4.3.2.3 Aggregated (S-57 PS 3.9)

C.4.3.2.4 Theme

C.4.3.2.4.1 Skin of the Earth Theme (S-57 PS 3.10.1)

C.4.3.3 Feature Relationship

C.4.3.3.1 Association

C.4.3.3.2 Aggregation

C.4.3.3.3 Composition

C.4.3.4 Information Types

C.4.3.5 Attributes

C.4.3.5.1 Numeric Attribute Values

C.4.3.5.2 Complex Attributes

C.4.3.5.3 Text Attribute Values

C.4.3.5.3.1 Text Placement

C.4.3.5.4 Mandatory Attribute Values

C.4.3.5.5 Missing Attribute Values

C.4.4 Feature Object Identifier.

Feature Object Identifier's must not be reused, even when a feature has been deleted.

C.4.5 Scale Independent and Scale Dependent Cells

C.4.6 Display

C.4.7 Geometry

C.5 Coordinate Reference Systems (CRS)

C.5.1 Introduction

C.5.2 Horizontal Coordinate Reference System

C.5.3 Vertical CRS for Soundings

C.6 Data Quality

C.7 Data Capture and Classification

C.8 Maintenance

C.9 Portrayal

C.10 Data Product format (encoding)

C.10.1 Introduction

C.10.1.1 Encoding of Latitude and Longitude

C.10.1.2 Encoding of Depths

C.11 Data Product Delivery

C.11.1 Introduction

C.11.2 Exchange Set

C.11.3 Dataset

C.11.3.1 Data Sets

C.11.3.2 Dataset file naming

C.11.3.3 New Editions, Re-Issues and Updates(S-57 PS 5.7)

C.11.4 Support Files

C.11.4.1 Support File Naming

C.11.4.2 Support File Management

C.11.5 Exchange Catalogue

C.11.6 Data integrity

C.11.6.1 ENC data integrity measures

C.11.6.2 Implementation

C.11.6.3 Processing

C.12 Metadata

C.12.1 Introduction

C.12.1.1 Exchange Set Metadata

C.12.1.2 Dataset Metadata

C.12.1.3 Support File Metadata

C.12.1.4 Exchange Catalogue File Metadata

C.12.2 Language