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IHO GEOSPATIAL STANDARD FOR NAVIGATIONAL WARNINGS

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Navigational Warnings - Product Specification

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Revision History

Changes to this Product Specification are coordinated by the IHO World-Wide Navigational Warning Service Sub-Committee (WWNWS-SC). New editions will be made available via the IHO web site. Maintenance of the Product Specification shall conform to IHO Technical Resolution 2/2007 (revised 2010).

Version Number	Date	Author	Purpose
0.0.1	2018-05-31	EM	Initial draft
0.0.1	2018-06-13	EM	Edits following SHOM comments
0.0.2	2018-10-31	EM	Implementing decisions of WWNWS10
0.0.3	2019-03-31	EM	Edits following CG review comments
0.0.4	2019-06-30	EM	Aligning the draft to S-100 Ed 4.0.0

Contents

1 Overview

1.1 Introduction

This document has been produced by the IHO World-Wide Navigational Warning Service Sub-Committee (WWNWS-SC). The purpose of this document is to respond to requests to produce a data product that can be used in a Navigational Warning Information Overlay (NWIO) within an Electronic Chart Display and Information Systems (ECDIS). It is based on the IHO S-100 framework specification and the ISO 19100 series of standards. It is a vector product specification that is primarily intended for encoding the nature and extent of Navigational Warnings, for navigational purposes.

S-124 is based on the guidelines set forth for navigational warnings in the Joint IHO/IMO/WMO Manual on Maritime Safety Information (MSI), IHO Publication S-53. It should be noted that although S-53 covers spectrum of MSI, S-124 focuses only on Navigational Warnings.

S-124 has been designed to permit utilization of S-124 datasets in creating Navigational Warnings for traditional Radio Broadcast, NAVTEX and within recognized mobile satellite service. This design feature aims to permit a greater sense of backwards compatibility, allowing production systems to share the same information in multiple channels for the greatest possible dispersion of safety critical navigational information.

S-124 Navigational Warnings are intended to be used in an overlay to nautical chart within a navigation system.

2 References

2.1 Normative

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

IHO/IMO/WMO S-53 Joint IHO/IMO/WMO Manual on Maritime Safety Information (MSI) January 2016 Edition

IHO S-100 IHO Universal Hydrographic Data Model Edition 4.0.0 (Release date is TBD).

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

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

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

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

ISO 19106:2004 Geographic Information - Profiles

ISO 19109:2005 Geographic Information - Rules for Application Schema

ISO 19111:2003 Geographic information - Spatial referencing by coordinates

ISO 19115:2015 Geographic information - Metadata

ISO 19131:2007 Geographic information - Data product specifications

3 Terms, Definitions and Abbreviations

3.1 Terms and Definitions

Commented [EM1]: To be reviewed when document is closer to finalized.

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

application

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

application schema

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

conceptual model

model that defines concepts of a **universe of discourse** (ISO 19101)

conceptual schema

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

data product

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

data product specification

detailed description of a **dataset** or **dataset series** together with additional information that will enable it to be created, supplied to and used by another party
NOTE: A data product specification provides a description of the universe of discourse and a specification for mapping the universe of discourse to a dataset. It may be used for production, sales, end-use or other purpose.

dataset

identifiable collection of data (ISO 19115)
NOTE: A dataset may be a smaller grouping of data which, though limited by some constraint such as spatial extent or feature type, is located physically within a larger dataset. Theoretically, a dataset may be as small as a single feature or feature attribute contained within a larger dataset. A hardcopy map or chart may be considered a dataset.

dataset series

collection of **datasets** sharing the same product specification (ISO 19115).
Distinction: series

domain

well-defined set (ISO/TS 19103)
NOTE: Well-defined means that the definition is both necessary and sufficient, as everything that satisfies the definition is in the set and everything that does not satisfy the definition is necessarily outside the set.

exchange set

datasets may be grouped into exchange sets. Each exchange set consists of one or more datasets with an associated XML metadata file and a single Exchange Catalogue XML file containing metadata. It may also include one or more support files.

feature

abstraction of real world phenomena (ISO 19101)
NOTE: A feature may occur as a type or an instance. Feature type or feature instance shall be used when only one is meant.

feature association

relationship that links instances of one **feature** type with instances of the same or a different **feature** type (ISO19110)
NOTE 1; A feature association may occur as a type or an instance. Feature association type or feature association instance is used when only one is meant.
NOTE 2: Feature associations include aggregation of features.

feature attribute

characteristic of a **feature** (ISO 19101)
NOTE 1: A feature attribute may occur as a type or an instance. Feature attribute type or feature attribute instance is used when only one is meant.
NOTE 2: A feature attribute type has a name, a data type and a domain associated to it. A feature attribute for a feature instance has an attribute value taken from the domain.

geographic data

data with implicit or explicit reference to a location relative to the Earth (ISO 19109)
NOTE: Geographic information is also used as a term for information concerning phenomena implicitly or explicitly associated with a location relative to the Earth.

In-force bulletin

a list of serial numbers of those NAVAREA, Sub-area or coastal warnings in force issued and broadcast by the NAVAREA Coordinator, Sub-area Coordinator or National Coordinator.
NOTE: S-124 also includes local warnings in-force bulletin.

metadata

data about data (ISO 19115)

model

abstraction of some aspects of reality (ISO 19109)

navigational warning

Navigational warning means a message containing urgent information relevant to safe navigation broadcast to ships in accordance with the provisions of the International Convention for the Safety of Life at Sea, 1974, as amended.

portrayal

presentation of information to humans (ISO 19117)

quality

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

series

A series is a numbered sequence of navigational warnings of the same type (NAVAREA, sub-area, coastal or local) issued by an authority acting as official production agency. Rem: S-53 identifies NAVAREA coordinator, sub-Area coordinator, national coordinator for coastal warnings. As local warnings are out of the scope of S-53, the term of "coordinators" is not used for local warnings.

universe of discourse

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

3.2 Abbreviations

Commented [EM2]: To be reviewed when document is closer to finalized.

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

ECDIS	Electronic Chart Display and Information Systems
ENC	Electronic Navigational Chart
GMDSS	Global Maritime Distress and Safety System
GML	Geography Markup Language
IHO	International Hydrographic Organization
IOC	International Oceanographic Commission
ISO	International Organization for Standardization
MIO	Marine Information Overlay
MRN	Maritime Resource Name
NtM	Notice to Mariner
NW	Navigational Warning
NWIO	Navigational Warning Information Overlay
UML	Unified Modelling Language
URI	Uniformed Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
WMS	Web Map Service
WFS	Web Feature Service
WWNWS	World-Wide Navigational Warning Service, part of the maritime safety information service of the GMDSS
WWNWS-SC	IHO World-Wide Navigational Warning Service Sub-Committee
www	World Wide Web
WGS	World Geodetic System
XML	Extensible Markup Language
XSLT	eXtensible Stylesheet Language Transformations

3.3 Use of Language

Within this document, including appendices and annexes:

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

3.4 UML Notations

In this document, conceptual schemas are presented in the Unified Modelling Language (UML). Several model elements used in this schema are defined in ISO standards or in IHO S-100 documents. In order to ensure that class names in the model are unique ISO TC/211 has adopted a convention of establishing a prefix to the names of classes that define the TC/211 defined UML package in which the UML class is defined. Since the IHO standards and this product specification make use of classes derived directly from the ISO standards. This convention is also followed in this document. In the IHO standards class names are identified by the name of the standard, such as "S100" as the prefix optionally followed by the bi-alpha prefix derived from ISO standard. For the classes defined in this product specification the prefix is "S124" (note that the prefix will be removed before version 1). In order to avoid having multiple classes instantiating the same root classes, the ISO classes and S-100 classes have been used where possible; however, a new instantiated class is required if there is a need to alter a class or relationship to prevent a reverse coupling between the model elements introduced in this document and those defined in S-100 or the ISO model.

4 Overview

4.1 Specification Description

Title:	Navigational Warnings Product Specification.
Abstract:	This specification is developed for creating datasets containing navigational warning information primarily targeting use in ECDIS. Navigational warning means a message containing urgent information relevant to safe navigation broadcast to ships in accordance with the provisions of the International Convention for the Safety of Life at Sea,1974, as amended (S-53, 2.2.1.23). Use of Navigational Warning datasets in other systems than ECDIS is permitted.
Content:	A dataset conforming to this specification will contain all relevant information of an individual Navigational Warning. Datasets of a series are delivered by means of an exchange set. Additionally there will be relevant metadata about data quality, production authority, and publication date.
Spatial Extent:	Global coverage of maritime areas.
Specific Purpose:	The purpose of this document is to respond to requests to produce a data product that can be used in a Navigational Warning Information Overlay (NWIO) within an Electronic Chart Display and Information Systems (ECDIS). It is based on the IHO S-100 framework specification and the ISO 19100 series of standards. It is a vector product specification that is primarily intended for encoding the extent and nature of Navigational Warnings, for navigational purposes.

4.2 Data product specification metadata

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

Title: Navigational Warnings Product Specification.

S-100 Version: 4.0.0

S-124 Version: Working Draft 2.0.0

Date: 2019-06-30

Language: English

Classification: Unclassified

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

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

Identifier: S-124

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

4.3 Product Specification Maintenance

4.3.1 Introduction

Changes to S-124 will be released by the IHO as a new edition, a revision, or as a document that includes clarification. These are described below.

4.3.2 New Edition

New Editions introduce significant changes. New Editions enable new concepts, such as the ability to support new functions or applications, or the introduction of new constructs or data types. New Editions are likely to have a significant impact on either existing users or future users of S-124.

4.3.3 Revisions

Revisions are defined as substantive semantic changes. Typically, revisions will introduce change to correct factual errors; introduce necessary changes that have become evident as a result of

practical experience or changing circumstances. A revision must not be classified as a clarification. Revisions could have an impact on either existing users or future users this specification. All cumulative clarifications will be included with the release of approved corrections revisions.

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

4.3.4 Clarification

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

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

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

4.3.5 Version Numbers

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

New Editions denoted as **n**.0.0
Revisions denoted as n.**n**.0
Clarifications denoted as n.n.**n**

4.4 Specification Scope

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

Scope ID:	Navigational Warning datasets.
Hierarchical level:	MD_ScopeCode - 005
Hierarchical level name:	dataset.
Level description:	information applies to the dataset
Extent:	EX_Extent.description: Global coverage of maritime areas

5 Data product identification

title	Navigational Warning

abstract	Navigational Warning dataset is a vector dataset containing the extent and nature of Navigational Warnings, for navigational purposes.
acronym	NW
content	Navigational Warning information, such as characteristics of the Navigational Warning, new dangers, restrictions and regulations that require special attention.
spatialExtent	**Description:** Global **East Bounding Longitude:** -180 **West Bounding Longitude:** 180 **North Bounding Latitude:** 90 **South Bounding Latitude:** -90
temporalExtent	Datasets are valid till cancellation date, cancellation message or till removed from the inforce list, whichever comes first.
specificPurpose	Navigational Warning datasets are produced for navigational purposes within an ECDIS, and to allow the producer or issuer to exchange NW information with navigators.

Commented [YLF3]: Should be reviewed when the maintenance process will be defined.

Commented [ME4R3]: Added the option to cancel via inforce list.

6 Data Content and Structure

Model preserves structure from earlier versions to maintain compatibility with T & P notices that may have been implemented in early adoptions. The S124 prefix used on many feature types, information types and attributes. The prefix indicates the entity is unique to the S-124 data model, but is temporary and will be removed in later versions of this draft.

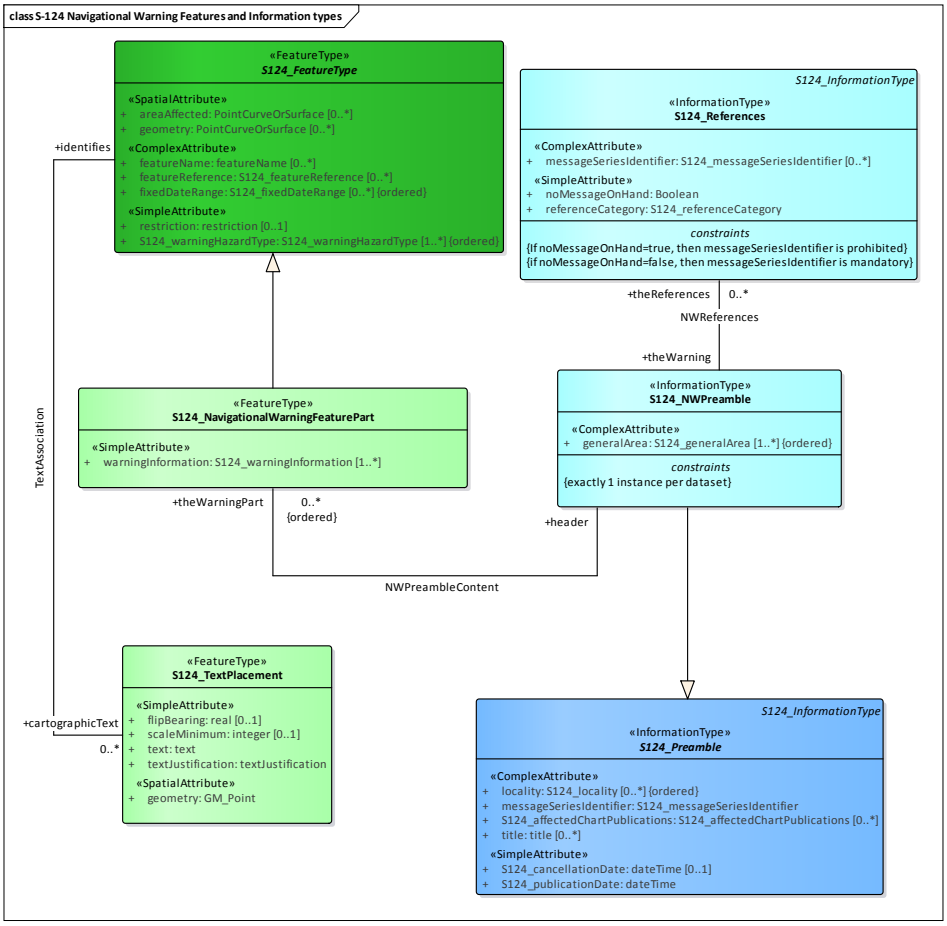


Figure 6.1 - S-124 Features and Info Types

Representation of the relationships between feature classes and information classes. There are two abstract classes, the information type S124_Preamble and the feature type S_124_FeatureType. These abstract classes are in the current form retrained from earlier version of the model when there was support for temporary and preliminary notices, to give a

continuity for early implementations where their function was to carry the shared attributes between NW and NtM classes.

All datasets must contain one and only one instance of S124_NWPreamble. This class is used to hold the meta-information about the navigational warning that the dataset encapsulates. The S124_References class is used when it is necessary to reference other Navigational Warnings, such as when cancelling an earlier Navigational Warning.

The warning information is carried in the S124_NavigationalWarningFeaturePart, and a dataset can contain zero to many of these as per need. Each S124_NavigationalWarningFeaturePart can geo locate a piece of warning information, meaning that a Navigational Warning with four shoals, should have four instances of S124_NavigationalWarningFeaturePart. Each instance of S124_NavigationalWarningFeaturePart can be associated with zero to many instances of S124_TextPlacement. This class is used to place text on the graphical display that it can be beneficial to geo locate for a more complete understanding of a Navigational Warning.

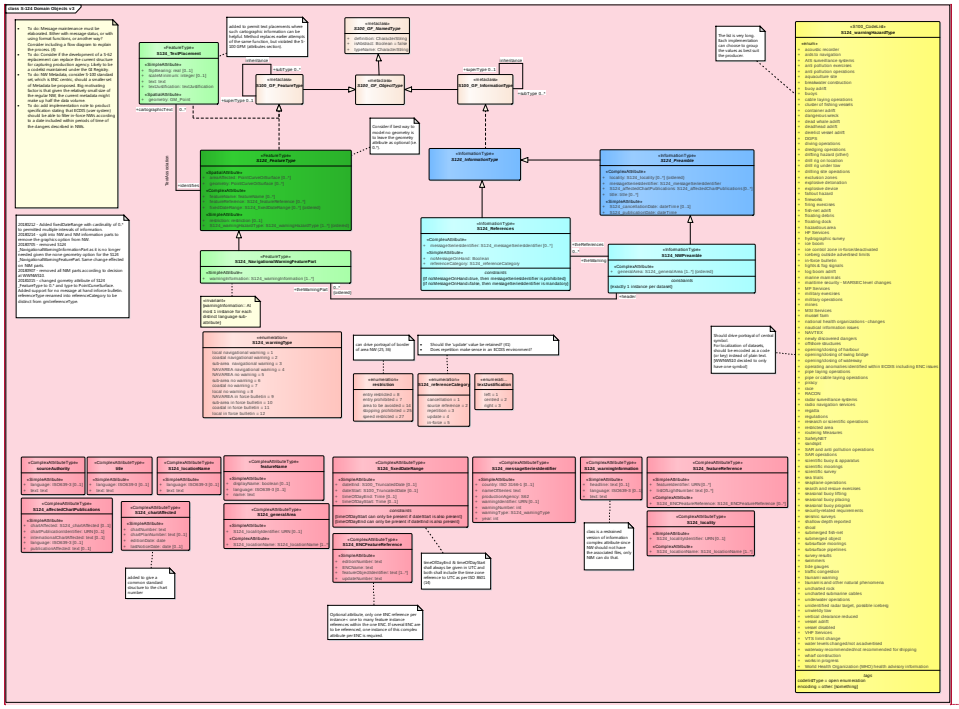


Figure 6.2 - The Full S-124 Data Model 0.2.4

Figure 6.2 shows the full S-124 data model, including several notes that have been added to annotate the data model with explanations for specific concepts and highlight outstanding issues.

Commented [ME5]: Some of the attributes are probably redundant with the removal of NtM. Discuss removing them at the workshop. Candidates for removal include; information, graphic, pictureCaptionOtherLanguage, pictureInformationOtherLanguage

Commented [ME6R5]: Removed the redundant attributes in this version to match validation tests.

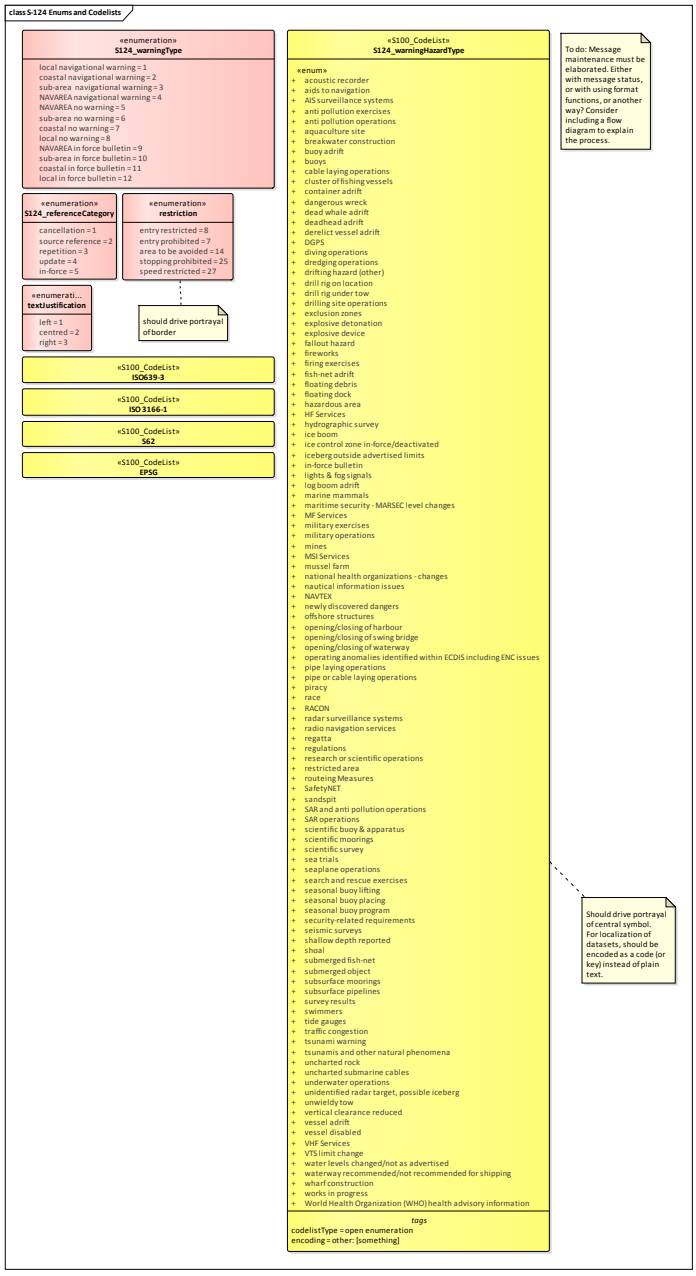


Figure 6.3 - S-124 Enumerations 0.2.4

Figure 6.3 shows all S-124 enumerations and codelists. The codelists for ISO 639-2 (language code), ISO 3166-1 (country code), S62 (IHO data producer code) and EPSG (horizontal datum code) have not been populated due to their length and since they are well defined elsewhere. S124_warningHazardType is an open enumeration codelist, meaning that in addition to all the hazard types listed, additional values can be defined by producers. It is recommended that as new needs are identified, requests for amendments to S-124 is made to standardize the hazard types as far as possible.

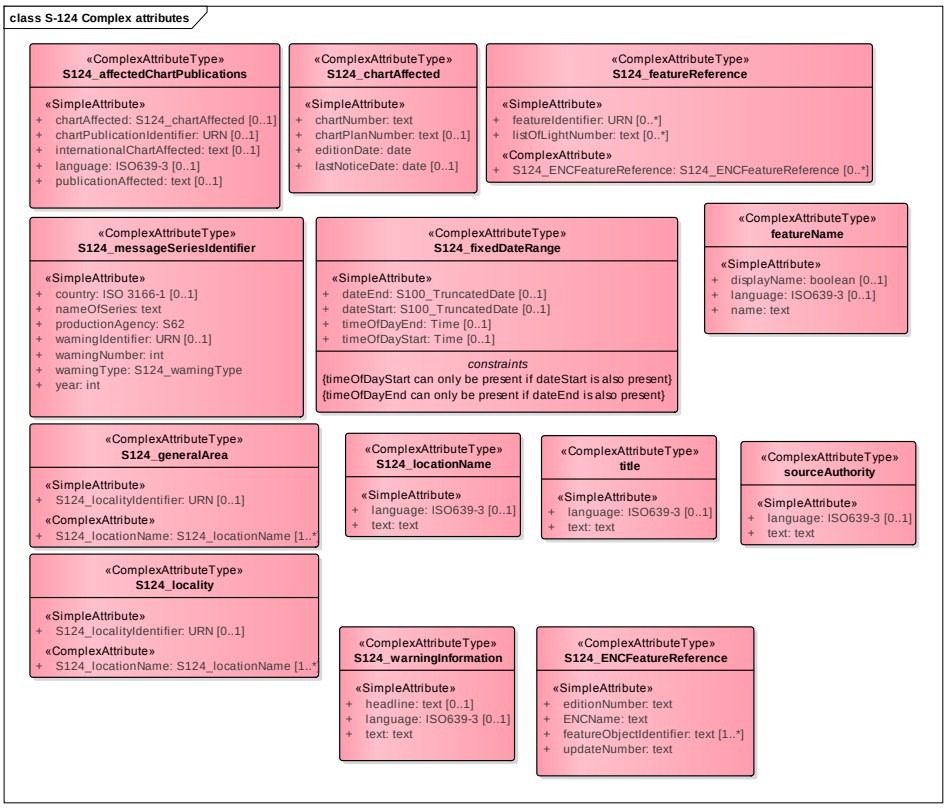


Figure 6.4 - S-124 Complex Attributes

Figure 6.4 shows all the complex attributes of the S-124 data model.

7 Feature Catalogue

7.1 Introduction

The Feature Catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in the product. The S-124 Feature Catalogue is available in an XML document which conforms to the S-100 XML Feature Catalogue Schema and can be downloaded from the IHO website (include URL here). Simple attributes used in this specification are listed in Table 7.1 – Simple feature attributes.

Name:	Navigational Warning Feature Catalogue
Scope:	Ocean, Coastal, Ports, Harbors and Inland waters
Version Number:	Draft Version 0.0.1
Version Date:	2018-07-31
Producer:	International Hydrographic Bureau, 4 quai Antoine 1er, B.P. 445 MC 98011 MONACO CEDEX Telephone: +377 93 10 81 00 Telefax: + 377 93 10 81 40 URL: http://www.iho.int
Language:	English

7.2 Feature Types

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

7.2.1 Geographic

A geographic (Geo) feature type carries the descriptive characteristics of a real world entity.

7.2.2 Feature Relationship

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

7.2.3 Information Types

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

7.2.4 Information Relationship

An information relationship likes instances of a feature or information type with another instance of an information type.

7.2.5 Attributes

S-124 defines attributes as either simple or complex.

7.2.5.1 Simple Attributes

S-124 uses ten types of simple attributes; they are listed in the following table:

Type	Definition
Enumeration	A fixed list of valid identifiers of named literal values
Boolean	A value representing binary logic. The value can be either True or False. The default state for Boolean type attributes (i.e. where the attribute is not populated for the feature) is False.
Real	A signed Real (floating point) number consisting of a mantissa and an exponent
Integer	A signed integer number. The representation of an integer is encapsulation and usage dependent.
Text	An arbitrary-length sequence of characters including accents and special characters from a repertoire of one of the adopted character sets
Date	A date provides values for year, month and day according to the Gregorian Calendar. Character encoding of a date is a string which must follow the calendar date format (complete representation, basic format) for date specified by ISO 8601. EXAMPLE 19980918 (YYYY-MM-DD)
Time	A time is given by an hour, minute and second. Character encoding of a time is a string that follows the local time (complete representation, basic format) format defined in ISO 8601. EXAMPLE 183059 or 183059+0100 or 183059Z
Date and Time	A DateTime is a combination of a date and a time type. Character encoding of a DateTime shall follow ISO 8601. EXAMPLE 19850412T101530
Codelist	A type of flexible enumeration. A code list type is a list of literals which may be extended only in conformance with specified rules.
Truncated date	One or more components of the Date type are omitted.
URN	A persistent, location-independent, resource identifier that follows the syntax and semantics for URNs specified in RFC 2141. EXAMPLE urn:mrn:iho:hydro:js:AnchorageArea01

Table 7.1 – Simple feature attributes

.

Note: the use of URN in S-124 shall be utilizing the schema of the Maritime Resource Name (MRN) concept.

Commented [EM7]: S-100WG is drafting an MRN guidance document. When finalized, it should be referenced here.

7.2.5.2 Complex Attributes

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

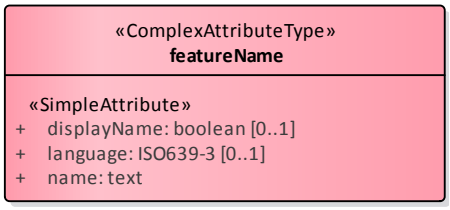


Figure 7.1 - featureName - a complex attribute

7.3 Units of Measure

There is no use of a specific unit of measure in the S-124 data model. However, the content of text attributes that describe the nature of navigational warnings may make use of the following units of measure;

- Orientation is given in decimal degrees
- Radio frequency is given in hertz
- Uncertainty is given in metres
- Horizontal distance is given in either metres (m) or kilometres (km) or nautical miles (NM), as indicated by the designation
- Depths are given in metres
- Heights are given in metres

Commented [ME8]: Discuss at workshop. Should it be more prescriptive given the primary user system is ECDIS and there many of these are prescribed.

Commented [ME9]: See S-53 **Standard Message Element Reference 7.** It states NM is the UOM for distances, but it is probably not intended for shorter distances.

7.4 Geometric Representation

Geometric representation is the digital description of the spatial component of an object as described in S-100 and ISO 19107. This product specification uses three types of geometries: GM_Point, GM_OrientableCurve, and GM_OrientableSurface. The feature classes defined in this specification can also use the no geometry geometric primitive. This option is reserved for cases where the geometry is too complex or the area is too large, such as whole NAVAREA warnings. In such cases a textual description of the area is expected.

Figure 7.2 - Geometric Primitives an overview of how the spatial model has been implemented in S-124. This includes the option to encode spatial uncertainty where this is required.

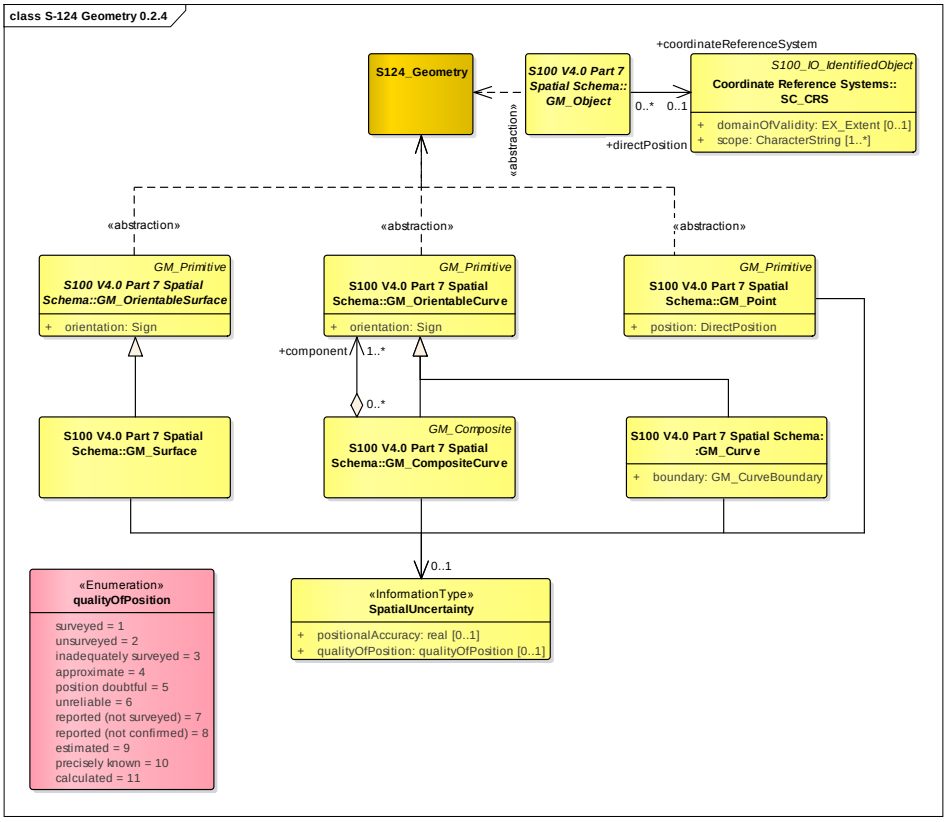


Figure 7.2 - Geometric Primitives

8 Coordinate Reference System (CRS)

8.1 Introduction

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

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

Horizontal coordinate reference system:	WGS 84
Projection:	None
Vertical coordinate reference system:	Although all coordinates in a data set must refer to the same horizontal CRS different Vertical Datums can be used for the depth component of a coordinate tuple. Therefore the vertical CRS can be repeated. For each Vertical CRS a unique identifier is defined. Those identifiers will be used to indicate which Vertical CRS is used. Units must be in metres. (From S-101 Draft).
Temporal reference system:	Gregorian calendar
Coordinate reference system registry:	EPSG Geodetic Parameter Registry
Date type (according to ISO 19115):	002 - publication

8.2 Horizontal reference system

Positional data is expressed in latitude and longitude geographic coordinates to World Geodetic System 84 (WGS 84).

8.3 Projection

Navigational Warning data products are un-projected.

8.4 Vertical coordinate reference system

Although all coordinates in a dataset must refer to the same horizontal CRS different Vertical Datums can be used for the depth or heights in Navigational Warning datasets. The S-124 data model does not use a specific unit of measure, however, the content of text attributes that describe the nature of navigational warnings may include information about heights or depths. When this is the case, the vertical datum used in the measurement shall be made clear from the text.

8.5 Temporal reference system

Time is measured by reference to Calendar dates and Clock time in accordance with ISO 19108:2002 Temporal Schema clause 5.4.4. All instances of time in datasets conforming to S-124 must be expressed in UTC. Time and date values must conform to the formatting requirements of the time and date datatypes.

Commented [ME10]: See S-53 Standard Message Element Reference 7 for format of date and time (date time group). S-100 follows ISO 8601:1988, and S-124 inherits this. It can be specified to be shown differently in the ECDIS, but the risk is that S-124 specify something different from what S-52 currently do.

Commented [ME11]: Are there any circumstances where time/date information must be included in the text attributes?

9 Data Quality

9.1 Introduction

Datasets conforming to S-124 must always be created with the best available source information. Due to the urgency of the information, datasets may be based on incomplete or unconfirmed information and mariners will need to take this into account when deciding what reliance to place on the information contained therein. It is often not possible to determine quantifiable values to measures of data quality. Generally the quality of information is evident

from the navigational warning text by the use of qualitative words such as '*approximate'*, *'reported'*, '*in the vicinity of*' and '*about*'.

Example: *Dredging operations will be taking place in the vicinity of Goldwood Sawmill (49°12'25"N / 123°04'50"W), in the Mitchell Slough starting on Saturday, February 2 to Monday, February 5.*

S-124 products must be tested with the S-124 specific checks prior to release by the data producer. The data producer must review the check results and address any issues to ensure sufficient quality of the data products. The checks are a mix of data format validation checks, conformance to standard checks and logical consistency checks. The checks are listed in Appendix E.

10 Data Capture and Classification

S-124 products are the result of the official production agency process. S-124 products must be based on data sources deemed reliable by the production agency. The Data Classification and Encoding Guide (DCEG) describes how data describing a Navigational Warning should be captured using the types defined in the S-124 Feature Catalogue, and is found in Appendix A. General principles for Navigational Warnings according to WWNWS, such as how to administer a NAVAREA, what constitute a sub area warning and coastal warning are found in S-53 - Joint IHO/IMO/WMO Manual on Maritime Safety Information (MSI). Local warnings are outside of scope of S-53, and will be defined in national or local documentation.

Commented [EM12]: To be created..S-53 contains much information that can be adopted in standard message element references and various notes throughout the document. S-124 training manual will contain S-124 equivalents of the various S-53 examples. These can serve as a starting point for Appendix A.

10.1 Data Encoding and Product Delivery

10.1.1 Data Encoding

The principal encoding is the Open Geospatial Consortium (OGC), Geography Markup Language (GML) format as profiled by the S-100 GML schema in Part 10b of S-100. GML is an XML grammar designed to express geographical features. It serves as a modelling language for geographic systems as well as an open interchange format for geographic transactions.
The XML Schema for the GML application schema is provided at (http://www.iho.int/schemas/…). Feature instance shall validate against the schema and conform to all other requirements specified in this data product specification including all constraints not captured in the XML Schema document.

10.1.2 Types of Datasets

A Navigational Warning is communicated via a dataset. A dataset is a grouping of features, attributes, geometry and metadata which comprises a specific coverage. There are five types of S-124 datasets, and a dataset must contain only one Navigational Warning or In-force Bulletin.

Dataset type	Explanations
New dataset	Dataset with a new warning. The dataset is valid till a cancellation dataset is issued.
New dataset self-cancelling	Dataset with a new warning that include a cancellation date.
New dataset with cancellation	Dataset used to cancel previous warning. May include updated information related to the warning that is being cancelled.
New dataset with cancellation self-cancelling	Dataset used to cancel previous warning. May include updated information related to the

	warning that is being cancelled. Includes a cancellation date.
In-force bulletin	Dataset that reference all in-force navigational warnings, and always cancel the previous in-force bulletin.

Table 10.1 - Dataset types

10.1.2.1 Content of Datasets

All datasets must contain one, and only one, instance of the information type Preamble.

- New dataset - Dataset with warning information that is valid till another dataset with cancellation information is issued. Dataset will contain at least one NavigationalWarningFeaturePart instance, and may contain one or more TextPlacement feature type instance and/or References information type instances.
- New dataset self-cancelling - Dataset with warning information that is valid till the cancellation date in the preamble. Dataset will contain at least one NavigationalWarningFeaturePart instance, and may contain one or more TextPlacement feature type instance and/or References information type instances.
- New dataset with cancellation – Dataset that can contain updated information to a previously issued dataset, and will contain cancellation information for at least one previous dataset. Dataset will contain at least one References information type instances and may contain one or more NavigationalWarningFeaturePart and TextPlacement instances.
- New dataset with cancellation self-cancelling - Dataset that can contain updated information to a previously issued dataset, and will contain cancellation information for at least one previous dataset. Dataset is valid till the cancellation date in the preamble. Dataset will contain at least one References information type instance and may contain one or more NavigationalWarningFeaturePart and TextPlacement instances.
- In-force bulletin – Dataset that references all navigational warnings that are valid at the time of issue. In-force bulletin datasets always cancel the previous in force-bulletin. Dataset will contain one Preamble , and may contain one or more References information type instances and must not contain any NavigationalWarningFeaturePart or TextPlacement instance.

Commented [EM13]: To account for 'no message at hand'

10.1.3 In-force bulletin dataset

All datasets must be considered in-force and valid till a new dataset with cancellation information is issued or where cancellation date is present in a dataset, that date is not passed.

Commented [ME14]: Should in force bulletins self-reference? What is the technical implication of that?

The in-force bulletin must not be used by a producer to cancel valid datasets, that function is reserved for a new dataset with cancellation information for previously issued datasets.

Commented [EM15]: May need to revisit this statement for push services.
To do -> create a timeline of what happens to NW received by a ship that enters and leaves the zone and then re-enter a few weeks later. This can be a first test to see how the defined messages function in a push service.

10.1.3.1 No message on hand

When there are no active warnings in a series, the regularly issued in-force bulletin dataset must be encoded with an NWPreamble associated with only one instance of References. The

References instance shall have referenceCategory set to in-force, and noMessageOnHand set to true.

10.2 Encoding of Latitude and Longitude

Coordinates must be encoded as decimals in the format described in 10.2.1. Values of latitude and longitude must be accurate to 7 decimal places. The encoding is indicated by multiplication factor fields defined in the Dataset Structure Information field.

10.2.1 Encoding of coordinates as decimals

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

The decimal point must be indicated by the "." character (punctuation).

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

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

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

Commented [ME16]: Evaluate the need to retain this since GML seems to store coordinate tuples in float values.

10.3 Numeric Attribute Encoding

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

10.4 Text Attribute Values

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

10.5 Mandatory Attribute Values

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

- They determine whether a feature is to be displayed,
- 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 Appendix A – Data Classification and Encoding Guide.

Commented [ME17]: Need to create

Commented [ME18]: Need to create

10.6 Unknown Attribute Values

Mandatory attributes in an S-124 dataset are not permitted to contain a nil value. All mandatory attributes must contain meaningful data.

10.7 Structure of dataset files

10.7.1 Sequence of objects

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

Dataset Identification (described in S-100 Part 10b-9-6.1)
Dataset Structure Information (described in S-100 Part 10b-9-6.2)
Spatial records for by-reference geometries
- Point
- Multi point
- Curve
- Composite Curve
- Surface

Information objects
Feature objects (Geometry may be encoded inline or by reference, see S-100 Part 10b-9-4.1.)
- Meta features
- Geo features

10.8 Object identifiers

The “name” of feature records must provide a unique world-wide identifier of feature records following the MRN schema. [To be updated when MRN guidance document has been finalized]

The MRN schema is structured as follows; urn:mrn:OID:OSS

OID is an identifier like IHO, IALA, IMO etc

OSS are ids provided by the organization identified by the OID, which can create them, handle them, delete them, store them in registries as they see fit. An organization that issues an MRN ID must make sure that THEIR OSS is not used twice for different purposes. Together with the individual OID the resulting MRN are globally unique.

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

[**To do**: add something about linking S-124 Navigational Warnings with same Navigational Warning received via NAVTEX, recognized mobile satellite service, or other distribution channel and giving preference to S-124]

10.9 Data coverage

A common feature of S-100 based datasets is a data coverage meta feature class. Navigational Warnings, are however more resemble messages and contain only the essential information to communicate urgent safety information. Therefore a distinct meta feature class to mark the data

Commented [ME19]: Should it remain, or be changed to dataset ID?

Commented [ME20]: Message series identifier is another unique world-wide identifier. But it requires an S-62 code, which it is likely that many NW issuers must apply for. Given the option of local NWs it is probably necessary with many producers in each country. This may put pressure on S-62 to move to a 4 character code as proposed at S-100WG3.

Commented [ME21]: May need to add an attribute to the NW feature part.

coverage is not included. The discovery metadata associated with each S-124 dataset fulfills this function.

10.10 Data overlap

S-124 datasets may overlap other S-124 datasets.

10.11 Data quality

Navigational Warning datasets are always compiled from best available sources. These sources often do not contain sufficient details to make an assessment regarding quantitative data quality. This fact, in combination with the general urgency of distributing Navigational Warning information are the primary reasons why no quantitative quality attributes have been added to S-124.

All S-124 datasets must pass validation checks as detailed in Appendix E, without any critical errors.

10.12 Use of datasets

S-124 datasets are intended to be used as an overlay over a nautical chart. This means that S-124 datasets must be created with content sufficient to communicate the intended information to a user when the user views the datasets over the chart display. This includes sufficient accuracy of location information, as well as sufficient levels of details on the navigational safety information contained in the S-124 dataset.

10.13 Scale in S-124 datasets

Navigational Warning data must be compiled in the best applicable scale. The use of the data itself is scale independent. That means that the data can be used at any scale.

10.14 Filtering Navigational Warning information

User systems may provide filtering mechanisms for the Navigational Warning information. Filtering functions could include options like filtering on route + buffer, navigational warning topic, date range of the hazard, or valid time of the navigational warning.

Example: A self cancelling dataset with a preamble with publication date of 20190704T010000Z and a cancellation date of 20190711T000000Z, and a NavigationalWarningFeaturePart with a fixed date range of 20190706T010000Z to 20190710T010000Z must be visible during 20190706T010000Z to 20190710T010000Z and optionally visible during 20190704T010000Z to 20190706T005959Z, and during 20190710T010001Z to 20190711T000000Z.

Note: When a NavigationalWarningFeaturePart is not portrayed, any associated TextPlacement features must also not be portrayed.

11 Data Delivery

11.1 Data Product Delivery Information

This data product specification defines GML as the primary format in which S-124 data products are delivered. The delivery format is described by the following items (from ISO 19131:2005): format name, version, specification, language, character set.

Name	ISO 19131 Elements	Value
Format name	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.formatName	GML*
Version	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.version	3.2.1
Specification description	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.specification	GML*
Language	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.language	English English
Character set	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.characterSet > MD_CharacterSetCode	004 – utf8

Table 11.1 - Data Product Delivery

11.2 Dataset loading

11.2.1 Use of S-124 in ECDIS

In ECDIS all valid S-124 datasets must always be loaded. Validity is indicated by the cancellationDate attribute in the NWPreamble class, and any point in time prior to this time value the dataset is valid. If the cancellationDate attribute is empty this means the dataset is valid till cancelled by a new dataset. Validity is terminated if a cancellation dataset is issued before the cancellationDate of a dataset.

Validity is also indicated by the NW being present in the latest in-force bulletin, and any dataset not found in the latest in-force bulletin must be considered not valid.

11.2.2 Section for producer Technical Service

To be further developed

A maritime safety broadcast[1] client system must be registered into the producer technical service. It is recommended that other client systems be also registered.

The producer technical service must deliver on request from client systems:

- the list of the Navigational Warning Series of the producer
- the complete set of in-force NW datasets in any selected series

Commented [ME22]: Considerations should also be given to how S-100 Part 14 (Online Communication Exchange) may work for a NW service.

[1] Broadcast in push mode

- the valid in-force bulletin dataset of a selected series. The valid in-force bulletin dataset must be synchronized with valid NW datasets issued.
- The NW datasets corresponding to a list of IDs of selected NW datasets of available series.

The producer technical service should deliver on request from client systems:
- information about production process of a series for quality management purposes.
- quality metadata of a series

The producer technical service must notify a registered client system participating to maritime safety when a vital or an important NW dataset is issued in series subscribed by the client. This notification includes the NW dataset.
The producer technical service may notify a registered client systems when a new in-force bulletin dataset is issued in a series subscribed by the client. This notification includes the new in-force bulletin dataset.

Commented [ME23]: It is difficult to see how these would be created for a NW service. Maybe some lessons available from STM Validation Project.

11.2.3 Section for push broadcast systems using the producer TS (radio stations …)

To be further developed

Commented [YLF24]: 24/07 Push broadcast

For using the technical service of a producer, a maritime safety broadcast client systems must be registered into the producer technical service and must subscribe to the series that it supports.
A maritime safety broadcast systems using the producer technical service must be able to send the requests described above to the producer technical service and to proceed with the replies. It must be able to receive the notifications described above from producer technical service and to proceed with them.
Maritime safety broadcast systems must broadcast simultaneously all valid NW datasets and the valid in-force bulletin dataset of a supported series at each scheduled broadcast.
A vital or an important NW dataset must be broadcast quickly as possible.

Commented [YLF25]: 24/07: tentative for push scenario

11.3 In-force bulletin

If the in-force bulletin contain NW that are not present in the system, an indication should be given.

11.4 Dataset cancellation

S-124 Datasets may be cancelled in four ways;

- by populating the cancellationDate attribute, and that date has passed. The user system should mark the dataset cancelled;
- or sending a cancellation dataset which contain only on instance of a References information type with the referenceType attribute set to 1 (cancellation), and the messageReference with the identifier of the datasets to be cancelled.
- or sending a new dataset with updated information and a References information type with the referenceType attribute set to 1 (cancellation), and the messageReference with the identifier of the previous datasets to be cancelled.
- Or any S-124 dataset in a user system that is not present on the most recent in-force list should be marked cancelled.

Commented [YLF26]: 24/07: I would be happy to know more about ideas around the pull scenario. I am afraid that it would be more demanding (less robust, more expensive) in terms of datalink-connexion, data services-clients management. Perhaps, pull scenario can also use in force-bulletins (a NW not in the in force-bulletin is no more valid) rather than the search of an old (and stored ?) cancellation dataset by the server of the producer. Push and pull scenarios have to be discussed within the group and the WWNWS-SC.

Commented [ME27R26]: A discussion of push and/or pull will be on the agenda for the upcoming S-124 workshop.

11.5 Updating datasets

In order to update the information provided in a S-124 datasets, a new dataset which cancel the previous information and contain updated information must be issued and applied to the user system.

11.6 Exchange Set

Datasets which conforms to this product specification must be delivered by means of an exchange set. [To be revisited to consider if suitable for both push and pull distribution.]

An exchange set must consist of one or more S-124 datasets. An exchange set may also include one or more support files containing a feature catalogue or portrayal catalogue. Each exchange set will include a single (XML) catalogue file, S-124 exchange set catalogues conform to S-100 4.0.0 Figure 4a-D-2 without modification, containing discovery metadata for each NW dataset as well as support files. S-124 Exchange set structure conforms to S-100 4.0.0 Figure 4a-D-3 without modification.

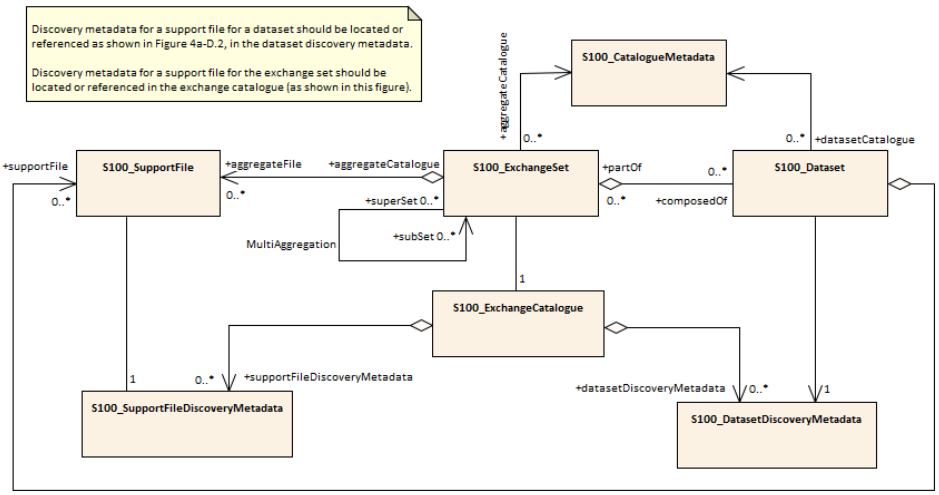


Figure 11.1 - Exchange set structure

Note: Exchange sets without a dataset are only permissible when used to exchange a feature and/or portrayal catalogue.

11.7 Dataset size

S-124 datasets must not exceed 50KB

Commented [EM28]: Just a guess. Suggestions have also been made on specifying the exchange set size. Need further discussion on this point since there is no limit to amount of datasets in one exchange set.

11.8 Support Files

For Navigational Warnings, support files are limited to new versions of either of the feature or portrayal catalogues.

11.9 Dataset Naming Convention

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

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

124YYYYXXXXXXX.GML

The main part forms an identifier where:

- the first three characters identify the dataset as an S-124 Navigational Warning;
- the fourth to seventh characters identify the issuing agency of the NW [according to S-62?];
- the eighth up to the fifteenth character can be used in any way by the producer to provide a unique file name for the dataset. The following characters are allowed in the dataset name, A to Z, 0 to 9 and the special character _ (underscore). It is not mandatory to use all characters in this group.

Commented [ME29]: Confirm that S-62 will be updated to a 4 character code.

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

11.10 Catalogue File Naming Convention

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

12 Data Maintenance

12.1 Introduction

S-124 datasets in a series are issued as per any situation arise requiring safety critical information be made known to mariners. Datasets of the series are maintained as needed and must be done according to section 11.2. When related of the same event, series dataset updates will be made by new datasets which cancel any preceding datasets.

Data Producers must use applicable sources to maintain and update data and may provide a brief description of the sources that were used to produce the dataset if this information is relevant. It is up to the Data Producer to determine what an appropriate source when creating Navigational Warning datasets is. S-53 chapter 3 ‘NAVAREA/SUB-AREA/NATIONAL COORDINATORS' RESOURCES AND RESPONSIBILITIES’ gives further information on how to manage information streams when creating S-124 Navigational Warnings within the WWNWS framework. Local warnings may be subject to national or regional guidelines.

The specific production process is up to each Data Producer. The Data Producer should sufficiently document their individual production process for quality management purposes.

12.2 Production process datasets

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

Commented [EM30]: To be created

12.3 Information updates

The purpose of issue of the dataset is indicated in the "purpose" field of the dataset discovery metadata. In order to cancel a dataset, one of the methods described in 11.4 is followed. To update information a new dataset with updated information is issued including cancellation information for previously issued datasets on the same topic.

Commented [ME31]: From Yves LeFranc: The purpose may be always the same: "navigational warning", or "in-force bulletin" or their definition, or something related to type of data set (10.1.2). To be seen in the DCEG.

12.4 Support file updates

The purpose of issue is indicated in the "purpose" field of the support file discovery metadata. Support files carrying the "deletion" flag in metadata must be removed from the system

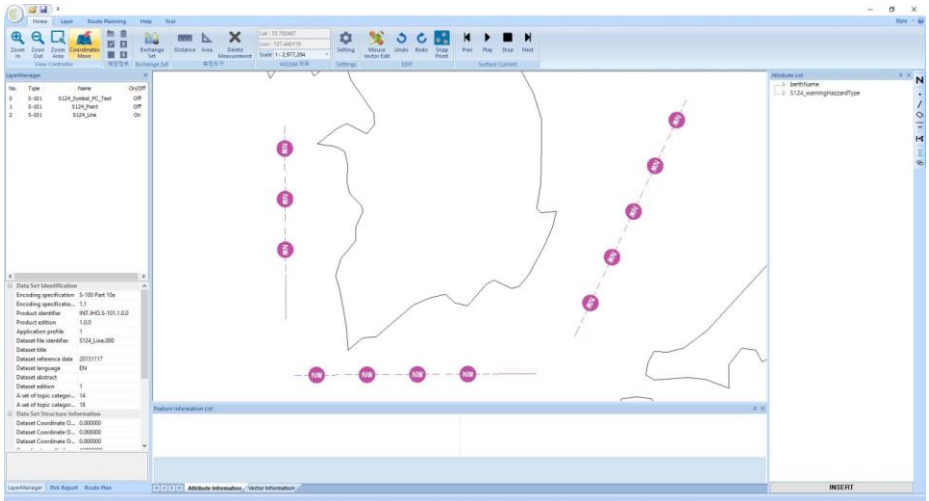
12.5 Feature and portrayal catalogues

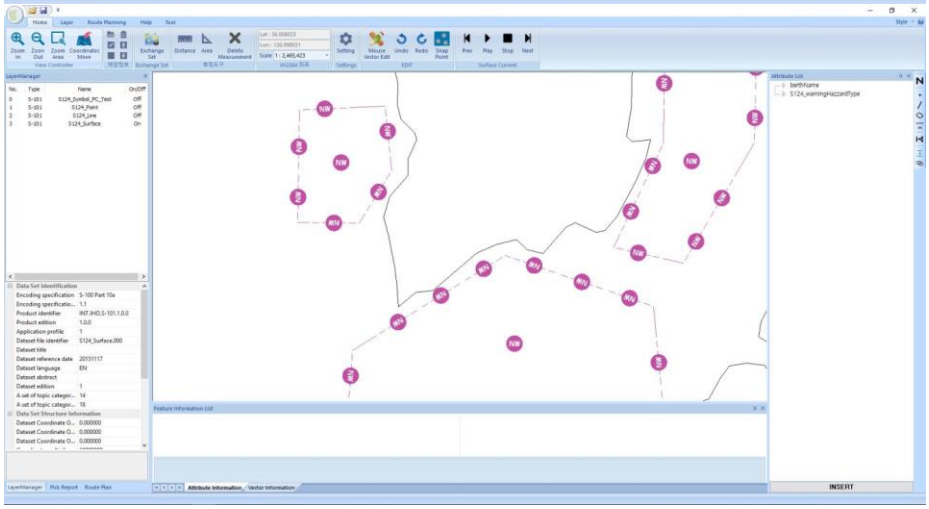
For each new edition (**n**.0.0, see 4.3.5) of the S-124 Product Specification a new feature and portrayal catalogue will be released. A revision (n.**n**.0) may also include a new feature and/or portrayal catalogue. The system must be able to manage datasets and their catalogues that are created on different versions of the S-124 Product Specification.

13 Portrayal

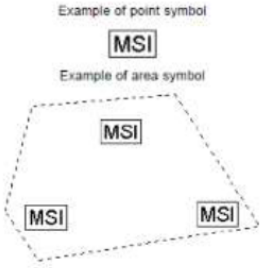
Navigational Warnings portrayal is provided by a portrayal catalogue that includes a symbol set and symbol instructions for the various feature and attribute combinations. Appendix F contains the portrayl catalogue using the XSLT concept from S-100.

Note: First version is created for test in the SMART Navigation Project and is only added for stimulating discussion and further development in S-124CG.





IMO SN.1/CIRC.243 Rev 2 Guidance for MSI portrayal was approved by IMO MSC 101 and gives guidance on how to portray MSI information. Unfortunately, this guidance does not distinguish between Navigational Warnings, Meteorological Warnings and other safety information. Moreover, the set implementation dates of this guidance is for

Topic	Symbol	Description
MSI		MSI point symbol should be presented as a box with the "MSI" inscribed inside it. The box should be centred at the position derived from the MSI message. The box should be drawn using a thick solid line style. The MSI area symbol should be presented as a series of lines bounding a geographic area designated as "caution" to navigation. Connecting lines should be drawn using thin dashed line style and using the same basic colour as the symbol itself. The area should be filled with a sparse pattern of MSI point symbols. Note that the source of MSI may be NAVTEX, AIS ASM function identifier 22 or 23 (SN.1/Circ.289), etc.

When the dataset is cancelled it must not be displayed on the navigation system when it is used in route monitoring mode.

Commented [ME32]: The NSCR 6 report includes the following statement, which may give some indications of permitting amendments to a portrayal that is more specific to NW;

5.9 As there was no time for developing new symbols at this stage, and recognizing a need to avoid conflicts with the presentation and display of information received on board for use in navigation equipment, the Group noted that several international organizations were developing information product specifications that would make available revised or new information in the coming years. The Group also noted that the IHO's S-100 Working Group was dealing with harmonization issues between developing information product specifications within their remit, and in this respect, encouraged participation in the IHO's S-100 Working Group. The Group was of the view that after completing its work on e-navigation maritime services, the Organization should continue its work on the harmonized display of information received by communications equipment by revisiting the Interim guidelines for the harmonized display of navigation information received via communication equipment (MSC.1/Circ.1593).

14 Metadata

14.1 Introduction

The S-124 metadata description is based on the S-100 metadata document section, which is a profile of the ISO 19115 standard. These documents provide a structure for describing digital geographic data and define metadata elements, a common set of metadata terminology, definitions and extension procedures.

Two metadata packages are described in this product specification: dataset metadata and exchange set metadata.

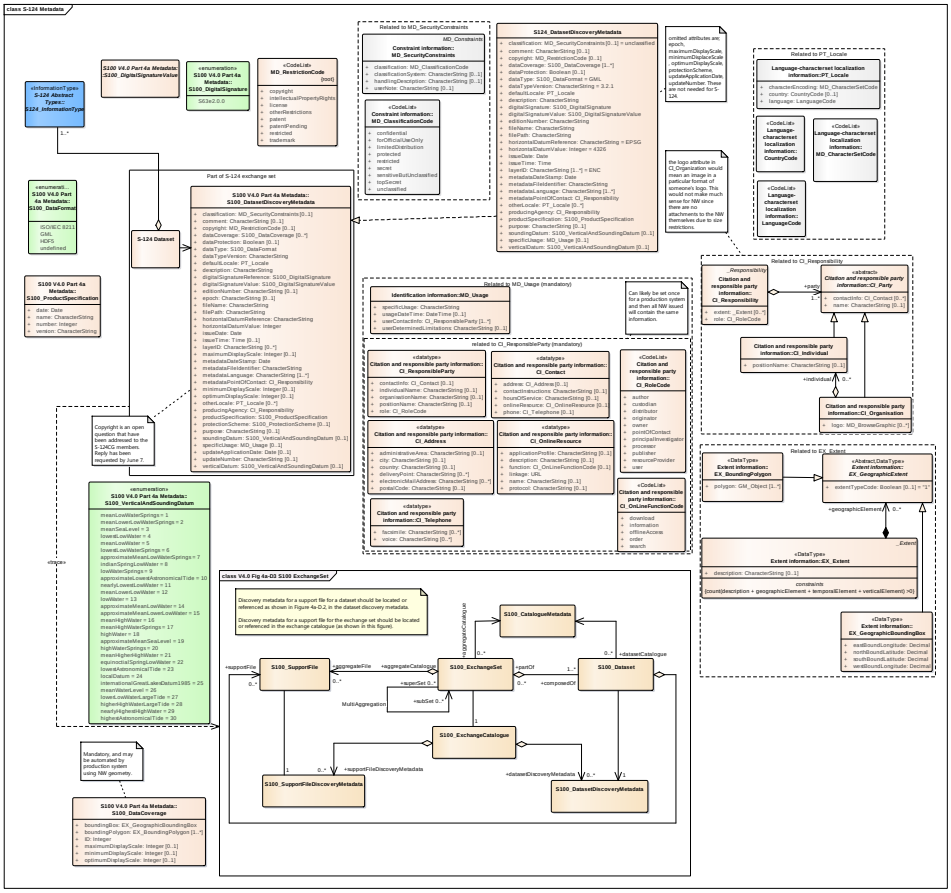


Figure 14.1 – Overview of [draft] Metadata

Note 1: Types with CI_, EX_, and MD_ prefixes are from packages defined in ISO 19115 and adapted by S-100. Types with S100_ prefix are from packages defined in S-100.

14.2 Dataset metadata

Dataset metadata is intended to describe information about a dataset. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of a dataset. Discovery metadata is often used for building web

Commented [ME33]: An alternative to datasets and required metadata is to develop S-124 as a service (see S-100 Part 14). This could significantly reduce the data volume of S-124 NW as metadata would only be needed at the beginning of each session, and not with each dataset. To be discussed at S-124 workshop.

catalogues, and can help users determine whether a product or service is fit for purpose and where they can be obtained.

14.2.1 Metadata for datasets

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

Name	Multiplicity	Value	Type	Remarks
S100_DataSetDiscoveryMetadata			Class	The following S-100 attributes are not used: epoch, maximumDisplayScale, minimumDisplaceScale, optimumDisplayScale, protectionScheme, updateApplicationDate, updateNumber.
fileName	1		CharacterString	Dataset file name (see 11.9)
filePath	1		CharacterString	Full path from the exchange set root directory
description	1		CharacterString	Short description of the area covered by dataset, e.g., area, harbour, or port name, between two named locations etc.
dataProtection	0..1		Boolean	TRUE: Encrypted FALSE: Unencrypted
protectionScheme	0..1		S100_ProtectionScheme	See S-100 Appendix 4a-D.
digitalSignatureReference	1		S100_DigitalSignature	Specifies the algorithm used to compute digitalSignatureValue. S-100 Appendix 4a-D.
digitalSignatureValue	1		S100_DigitalSignatureValue	The value resulting from application of digitalSignatureReference. Implemented as the digital signature format specified in S-100 Part 15.
copyright	0..1		MD_LegalConstraints>MD_RestrictionCode <copyright> (ISO 19115-1)	"copyright" for copyrighted datasets, omitted otherwise
classification	0..1	(one of the literals from the ISO codelist)	Class MD_SecurityConstraints> MD_ClassificationCode (codelist) ISO 19115-1	"unclassified" for S-124 datasets
purpose	0..1	{1}	MD_Identification>purpose (character string)	"New dataset" for S-124 datasets
specificUsage	0..1		MD_USAGE>specificUsage (character string)	brief description of the resource and/or resource series usage

Commented [ME34]: All NAVAREA Coordinators that responded to request for their view on copyright stated their NWs were not copyrighted. Should the attribute be removed or remain as an optional attribute?

			MD_USAGE>userContactInfo (CI_Responsibility)	
editionNumber	1		CharacterString	Edition number is always “1” for S-124 datasets.
issueDate	1		Date	Date on which the dataset was generated.
issueTime	1		Time	Encoded only if time of issue is significant.
productSpecification	1		S100_ProductSpecification	See Notes below this table for constraints on values.
producingAgency	1		CI_Responsibility>CI_Organisation or CI_Responsibility>CI_Individual	Party responsible for generating the dataset. See S-100 Part 4a Tables 4a-2 and 4a-3.
horizontalDatumReference	1	EPSG	CharacterString	
horizontalDatumValue	1	4326	Integer	WGS84
dataType	1	GML	S100_DataFormat	The only value allowed is “GML”.
dataTypeVersion	1	3.2.1	CharacterString	
dataCoverage	1..*		S100_DataCoverage	See S-100 Appendix 4a-D.
comment	0..1		CharacterString	Any additional Information
layerID	1..*	S-101	CharacterString	Dataset must be used with ENC in an ECDIS.
defaultLocale	1		PT_Locale	S-100 Appendix 4a-D.
otherLocale	0..*		PT_Locale	S-100 Appendix 4a-D.
metadataFileIdentifier	1		CharacterString	For example, identifier for ISO 19115-3 metadata file
metadataPointOfContact	1		CI_Responsibility>CI_Individual or CI_Responsibility>CI_Organisation	See S-100 Part 4a Tables 4a-2 and 4a-3.
metadataDateStamp	1		Date	Metadata creation date, which may or may not be the dataset creation date
metadataLanguage	1..*		CharacterString	
--	0..*		Aggregation S100_SupportFileDiscoveryMetadata	One for each support file linked to this dataset and present in the exchange set.

Table 14.1 Dataset discovery metadata

NOTES:

1) Attribute *productSpecification*: The values of sub-attributes *name* and *version* must correspond to this version of the S-124 product specification. (Clause 4.2). The value of sub-attribute *number* must be the number assigned to this version of the S-124 product specification in the GI registry.

Commented [ME35]: When submitted

14.3 Support file metadata

Support file metadata (Table 14.) is intended to describe information about a data resource. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of a data resource. In S-124 the main purpose is the assist in distributing feature and portrayal catalogues.

Name	Multiplicity	Value	Type	Remarks
S100_SupportFileDiscoveryMetadata			Class	
fileName	1		CharacterString	
fileLocation	1		CharacterString	Path relative to the root directory of the exchange set. The location of the file after the exchange set is unpacked into directory <EXCH_ROOT> will be <EXCH_ROOT>/<filePath>/<filename>
purpose	1		S100_SupportFilePurpose	new, replacement, or deletion. Values "replacement" and "deletion" are allowed only when updating feature and/or portrayal catalogues.
editionNumber	1		CharacterString	When a data resource is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition.
issueDate	1		Date	
supportFileSpecification	1		S100_SupportFileSpecification	S-100 Appendix 4a-D.
dataType	1		S100_SupportFileFormat	Values XML, XSLT, and LUA are reserved for portrayal and feature catalogue files.
otherDataTypeDescription	0..1		CharacterString	
comment	0..1		CharacterString	
digitalSignatureReference	0..1		S100_DigitalSignature	Specifies the algorithm used to compute digitalSignatureValue. See **Error! Reference source not found.** and S-100 Appendix 4a-D.
digitalSignatureValue	0..1		S100_DigitalSignatureValue	The value resulting from application of digitalSignatureReference. Implemented as the digital signature format specified in S-100 Part 15.
defaultLocale	1		PT_Locale	See **Error! Reference source not found.** and S-100 Appendix 4a-D.

otherLocale	0..*		PT_Locale	See **Error! Reference source not found.** and S-100 Appendix 4a-D.

Table 14.2 Support file metadata

14.4 Exchange set catalogue and metadata

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

14.4.1 Exchange catalogue file

All S-124 Exchange Catalogue files must contain at least the mandatory metadata elements in Table 14..

Name	Multiplicity	Value	Type	Remarks
S100_ExchangeCatalogue			Class	
identifier	1		S100_CatalogueIdentifier	See Notes below this table.
contact	1		S100_CataloguePointOfContact	No special constraints on the S-100 class.
productSpecification	0..1		S100_ProductSpecification	Conditional on all the datasets using the same product specification. See note below this table for constraints on values.
metadataLanguage	1	English	CharacterString	All datasets conforming to this PS must use English language. A catalogue in English must be provided. Discovery metadata elements within catalogues have their own locale attributes and may be repeated in languages other than English.
exchangeCatalogueName	1	CATALOG.XML	CharacterString	Catalogue filename
exchangeCatalogueDescription	1		CharacterString	
exchangeCatalogueComment	0..1		CharacterString	Any additional Information
compressionFlag	0..1		Boolean	TRUE: compressed FALSE: not compressed If compressed, the method must be that specified in S-100 Part 15.
sourceMedia	0..1		CharacterString	

replacedData	0..1		Boolean	
dataReplacement	0..1		CharacterString	
datasetDiscoveryMetadata	0..*		Aggregation S100_DatasetDiscoveryMetadata	
--	0..*		Aggregation S100_CatalogueMetadata	Metadata for the feature, portrayal, and interoperability catalogues, if any
supportFileDiscoveryMetadata	0..*		Aggregation S100_SupportFileDiscoveryMetadata	

Table 14.3 S100_ExchangeCatalogue

NOTES:

1) Attribute *productSpecification*: Class **S100_ProductSpecification** is defined in S-100 Appendix 4a-D. The values of sub-attributes *name* and *version* must correspond to this version of the S-124 product specification. (Clause **Error! Reference source not found.**). The value of sub-attribute *number* must be the number assigned to this version of the S-124 product specification in the GI registry.

Commented [ME36]: When registered

14.5 Metadata about feature and other catalogues

S100_CatalogueMetadata describes feature, portrayal, and interoperability catalogues. This is an optional element that allows for descriptions of feature, interoperability, and portrayal catalogues that are delivered within the exchange set. This class is described in S-100 Part 4a Appendix 4a-D. S-124 uses the S-100 class without modification, with the following constraints on allowed values:

1) Attribute *productSpecification*: For feature and portrayal catalogues, the values of sub-attributes *name* and *version* must correspond to this version of the S-124 product specification. (Clause **Error! Reference source not found.**).
2) Attribute *productSpecification*: The value of sub-attribute *number* must be the number assigned to this version of the S-124 product specification in the GI registry.

Commented [ME37]: When registered

Appendix A. Data Capture and Encoding Guide

[To be done]

Commented [ME38]: Task for S-124 workshop to extract/copy out relevant information from this document. Maybe some information to be captured from the S-124 training materials, e.g. all the examples. Or add the S-53 Examples as they are?

Appendix C. Feature Catalogue

Name: Navigational Warnings Feature Catalogue
Scope:
Version Number: 1.0
Version Date: 2017-05-04
Producer:

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

Language: English

(See Annex with review print of Feature Catalogue.)

Appendix D-1. GML Data Format Overview

This data format conforms to the profile described in S-100 Part 10b, which is based on GML.

Commented [ME39]: New version of schema is needed. Plan to wait till after S-124 workshop to create it in hopes that the data model is finalized then.

Appendix E. Validation Checks

1. References

IHO S-58 ENC VALIDATION CHECKS Edition 6.1.0, September 2018
IHO S-97 Part C IHO data quality checklist [Draft 0.2, August 2018]

2. Abbreviation

PS – Product Specification
DCEG – Data Capture and Encoding Guide

3. Production validation checks for S-124 Navigational Warnings

The following checks are intended for production systems designed to produce S-124 Navigational Warning datasets. The checks can be administered at any time during the production phase. All checks should be considered as warnings, even though more severe classifications are available, due to the status of the development and lack of experience with system use of S-124 datasets, it is considered premature to classify any checks as error or critical error at this time. All operators and spatial expressions are defined in Annex A.

3.1 Check classification

C	Critical Error	An error which would make an MTM dataset unusable in ECDIS through not loading or causing an ECDIS to crash or presenting data which is unsafe for navigation.
E	Error	An error which may degrade the quality of the MTM dataset through appearance or usability but which will not pose a significant danger when used to support navigation.
W	Warning	An error which may be duplication or an inconsistency which will not noticeably degrade the usability of an MTM dataset in ECDIS.

3.2 Checks relating to S-124 Product Specification

Commented [ME40]: Check list will grow with experience.

No	Check description	Check message	Check solution	Conformity to
100	For each feature object where its geometry is not COVERED_BY the bounding box	Objects fall outside the coverage object.	Ensure objects are not outside of the limits of the cell.	GML schema
101	If the cell file size is greater than 50KB.	The cell is larger than 50KB in size.	Ensure that the cell is not larger than 50KB.	PS 11.7
102	For each feature record where the name is not unique WITHIN the dataset.	Duplicate FOIDs exist within the dataset.	Ensure that no duplicate FOIDs exist.	PS 10.8
103	If any mandatory attributes are not present.	Mandatory attributes are not encoded.	Populate mandatory attributes with a value.	PS 10.6

Commented [ME41]: Needs update to match the ID structure of NW

105	For each feature object with an attribute of type Float or Integer where the value contains zeroes before the first numerical digit or after the last numerical digit.	Values have been padded with non-significant zeroes. E.g. : For a flip fearing of 180 degrees, the value of flipBearing must be 180 and not 0180.00.	Remove non-significant zeroes.	PS 10.3
106	For each association between features instances, features instances and information instances, and between information instances that is not defined in the feature catalogue.	Wrong association used.	Use correct association type.	Logical consistency
107	For each role name on associations that is not defined in the feature catalogue.	Wrong role used.	Use correct role name.	Logical consistency
108	For each association that is not defined in the feature catalogue.	Unknown association is used.	Use association that is defined in the feature catalogue.	Logical consistency
109	For each role name that is not defined in the feature catalogue.	Unknown role name is used.	Use role name that is defined in the feature catalogue.	Logical consistency
110	For each association ensure associated classes are only those permitted by the feature catalogue.	Class is associated in an illegal association.	Ensure correct association is used between classes.	Logical consistency
111	For each role name ensure it is only used with permitted associations.	Role name is used on an illegal association.	Ensure correct role names are used on the association.	Logical consistency
112	Ensure dataset conformance to the GML schema.	Dataset does not conform to the GML schema.	Ensure conformance to the GML schema.	PS 10.1.1 & 11.1
113	Ensure all text fields are encoded using UTF-8.	Illegal character set used.	Change character encoding to UTF-8.	PS 10.4
114	For each feature instance where more than one featureName is present, and the name subattribute of two or more featureName instances is equal.	Values name sub attribute are identical.	Ensure that name subattributes are populated with the correct values.	Logical consistency
115	For each featureName subattribute with language not equal to eng, and where featureName subattributes with language equal to eng is not present.	Name is encoded in national language only.	Populate text attribute with English text.	Logical consistency
116	For each warning information subattribute with language not equal to eng, and where information subattribute with language equal to eng is not present.	Text is encoded in national language only	Populate name attribute with English text.	Logical consistency
117	If the horizontalDatum reference and value attributes of DataSetDiscoveryMetadata are Not equal to EPSG:4326 (WGS 84).	horizontalDatum reference and value are not EPSG 4326	Set the horizontalDatum reference and value attributes to EPSG 4326	PS 8.1, 8.2 and 14.2.1

118	If the file names in an exchange set are not in accordance with the Product Specification.	File names are not in accordance with the Product Specification.	Amend file names.	PS 11.9
119	For each feature instance that does not OVERLAP OR is WITHIN the bounding box.	Object outside area of coverage.	Remove object or amend coverage.	
120	For each feature instance which does not have a valid feature class label/code as defined by the feature catalogue.	Object has invalid feature class code.	Amend object class code.	Logical consistency
121	For each attribute which does not have a valid attribute label/code as defined by the feature catalogue.	Attribute has invalid attribute label/code.	Amend attribute label/code.	Logical consistency
122	For each feature object which contains attributes outside the list of permissible attributes for the feature class (as defined in the feature catalogue).	Attribute not permitted on feature class.	Remove attribute.	Logical consistency
123	If the order of the data in a dataset is not correct.	Incorrect data order.	Amend data order.	PS 10.7.1
124	For each attribute instance where the total number of instances exceed the permitted number of instances	Too many instances of attribute.	Ensure correct attribute encoding.	Logical consistency
125	For each feature instance where fixedDateRange subattributes dateEnd and dateStart are notNull AND their values are identical.	Object has identical values of periodicDateRange subattributes dateEnd and dateStart.	Ensure values of periodicDateRange subattributes dateEnd and dateStart are logical.	Logical consistency
126	For each feature instance where fixedDateRange subattribute dateStart is notNull AND dateEnd is Null OR not Present.	Object has dateStart without a value of dateEnd.	Populate dateEnd or remove dateStart.	Logical consistency
127	For each feature instance where fixedDateRange subattribute is notNull AND dateStart is Null OR not Present.	Object has dateEnd without a value of dateStart.	Populate dateStart or remove dateEnd.	Logical consistency
128	For each linear geometry which contains vertices at a density Greater than 0.3mm at 1:10000.	Vertex density exceeds the allowable tolerance.	Generalise edge(s).	PS 6.1

Commented [ME42]: Need to find a reference for this.

Annex A

1.0 Introduction

1.1 ISO 19125-1:2004 geometry.

This clause defines ISO 19125-2004 geometric terms used in this Annex.

1.1.1 Definitions for ISO 19125-1:2004 geometry

Note that these definitions are for the primitives defined by ISO 19125-1:2004 which are single point, single line, and single area geometry objects.

- *Polygon* – A Polygon has a geometric dimension of 2. It consists of a boundary and its interior, not just a boundary on its own. It is a simple planar surface defined by 1 exterior boundary and 0 or more interior boundaries. The geometry used by an S-57 Area feature is equivalent to a Polygon.

- *Polygon boundary* – A Polygon boundary has a geometric dimension of 1 and is equivalent to the outer and inner rings used by an S-57 Area feature.

- *LineString* – A LineString is a Curve with linear interpolation between Points. A LineString has a geometric dimension of 1. It is composed of one or more segments – each segment is defined by a pair of points. The geometry used by an S-57 Line feature is equivalent to a LineString.

- *Line* - An ISO 19125-1:2004 line is a LineString with exactly 2 points. Note that the geometry used by an S-57 Line feature is equivalent to a LineString, not a line in ISO 19125-1:2004 terms. In this document the term Line refers to an S-57 Line feature or a LineString which can have more than two points.

- *Point* – Points have a geometric dimension of 0. The geometry used by an S-57 Point feature is equivalent to an ISO 19125-1:2004 point.

- *Reciprocal* – inversely related or opposite.

The following table matches 19125-1:2004 geometric terms to S-57 terms:

ISO 19125-1:2004	**S-57**
Polygon	Area feature geometry OR Area
Polygon boundary	Outer and inner rings
LineString	Line feature geometry OR Line
Point	Point feature geometry OR Point

1.1.2 Definition of symbols used in ISO 19125-1:2004

I = interior of a geometric object
E = exterior of a geometric object
B = boundary of a geometric object
∩ = the set theoretic intersection
U = the set theoretic union
∧ = AND
Ú = OR
≠ = not equal
∅ = the empty or null set
a = first geometry, interior and boundary (the topological definition)
b = second geometry, interior and boundary (the topological definition)
dim = geometric dimension – 2 for Polygons , 1 for LineStrings, and 0 for Points

Dim(x) returns the maximum dimension (-1, 0, 1, or 2) of the geometric objects in x, with a numeric value of -1 corresponding to dim (Æ).

Note:
- Neither interior nor exterior include the boundary (i.e. I, E and B are mutually exclusive).
- The boundary of a Polygon includes its set of outer and inner rings.
- The boundary of a LineString is its end points except for a closed LineString, which has no boundary; the rest of the LineString is its interior.
- A Point does not have a boundary.

1.2 ISO 19125-1:2004 geometric operator relationships

In ISO 19125-1:2004 (see Reference [1]), the dimensionally extended nine-intersection model (DE-9IM) defines 5 mutually exclusive geometric relationships between two objects (Polygons, LineStrings, and/or Points). One and only one relationship will be true for any two given objects (see Reference [2]):

1. WITHIN
2. CROSSES
3. TOUCHES
4. DISJOINT
5. OVERLAPS

There are others that help further define the relationship:

1. CONTAINS
   - the reciprocal of WITHIN
   - Within is the primary operator; however, if **a** is not within **b** then **a** may contain **b** so CONTAINS may be the unique relationship between the objects.
2. EQUAL
   - a special case of WITHIN / CONTAINS.
3. INTERSECTS
   - reciprocal of DISJOINT
   - have at least one point in common
4. COVERS and is COVERED_BY
   - reciprocal operators
   - extends CONTAINS and WITHIN respectively
5. COINCIDENT

Note that COVERS, COVERED_BY, and COINCIDENT relational operators are not described in the ISO 19125-1:2004 document.

The formulas given in this annex (e.g. a.Disjoint(b) $\Leftrightarrow a \cap b = \varnothing$) are the generalized ones given for ISO 19125-1, not the more specific DE-9IM formulas (i.e. DE-9IM predicates). The generalized formulas use topologically closed notation (i.e. geometry includes the interior and boundary unless otherwise stated), whereas the DE-91M formulas refer to the interior and boundary of geometry separately. Note

that different versions of documents describing 19125-1 give different generalized formulas – this annex is using the formulas that are the most consistent with the DE-9IM predicates. If a generalized formula appears to contradict a DE-9IM predicate as defined in ISO 19125-1:2004, the DE-9IM predicate takes precedence. Software is expected to be consistent with DE-9IM predicates.

1.3 How the relationships apply to S-57 Features

Geometric relationships will be tested on an entire S-57 feature object as a single geometric entity. Note that S-57 Point, Line, and Area feature geometry is equivalent in ISO 19125-1:2004 terms to Point, LineString, and Polygon geometry respectively.

A Line feature in S-57 may be made up of several individual edges. The geometric relationship operators used with a Line feature will consider the sequence of edges as a single geometry (LineString).

A test on an Area feature will operate on the entire Polygon.

In an S-57 file a Line or Area feature may be split into pieces as a result of a cutting operation from a data source. In that case each feature record in the dataset is treated as a separate LineString or Polygon when testing geometric relationships.

If a test intends to operate only on a feature's specific components – Polygon boundary (all rings), Polygon outer ring, Polygon inner rings, edges, vertices, or nodes then it must make this explicit in the description of the test. When a specific linear portion is specified in a test (Polygon boundary, edge) then it is treated as a LineString while individual vertices or points will be treated as points.

For example a test to look for cases where object class A OVERLAPS object class B would operate on the entire geometry. While a test to see if boundary of Area object class A OVERLAPS an edge of Line class B will be comparing Area boundaries to edges using Line to Line comparisons.

2.0 Geometric Operator Definitions

The ISO 19125-1 definitions referenced in this clause refer to clause 6.1.14.3 entitled "Named spatial relationship predicates based on the DE-9IM" in the ISO 19125-1:2004 document.
(In the diagrams within this annex LineString corresponds to the S-57 Line geometric primitive)

EQUALS – Geometric object **a** is spatially equal to geometric object **b**.
The two geometric objects are the same. This is a special case of WITHIN.

Examples of the EQUALS relationship

Note: ISO 19107:2003 describes equality more formally as:

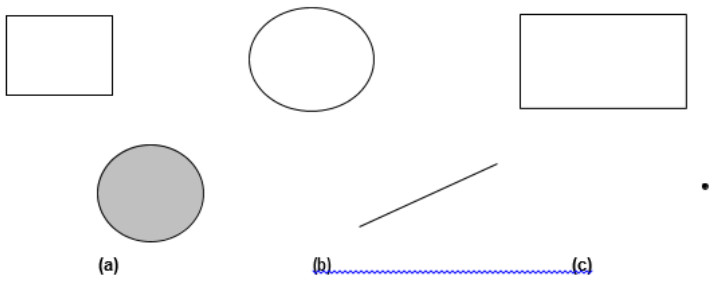
> Two different GM_Objects are equal if they return the same Boolean value for the operation GM_Object::contains for every tested DirectPosition within the valid range of the coordinate reference system associated to the object.
> NOTE Since an infinite set of direct positions cannot be tested, the internal implementation of equal must test for equivalence between two, possibly quite different, representations. This test may be limited to the resolution of the coordinate system or the accuracy of the data. Application schemas may define a tolerance that returns true if the two GM_Objects have the same dimension and each direct position in this GM_Object is within a tolerance distance of a direct position in the passed GM_Object and vice versa.

For the purposes of S-127 Validation Checks, a GM_Object is any spatial object as described in A.1.1 (Polygons, LineStrings, and Points). A spatial object is always equal to itself, i.e., **a** EQUALS **a** is always true.

DISJOINT – Geometric object **a** and geometric object **b** do not intersect.
The two geometric objects have no common points.
The ISO 19125-1 definition of DISJOINT is:

$$\boldsymbol{a}.Disjoint(\boldsymbol{b}) \Leftrightarrow \boldsymbol{a} \cap \boldsymbol{b} = \varnothing$$

This translates to: **a** is disjoint from **b** if the intersection of **a** and **b** is the empty set.



Examples of the DISJOINT relationship

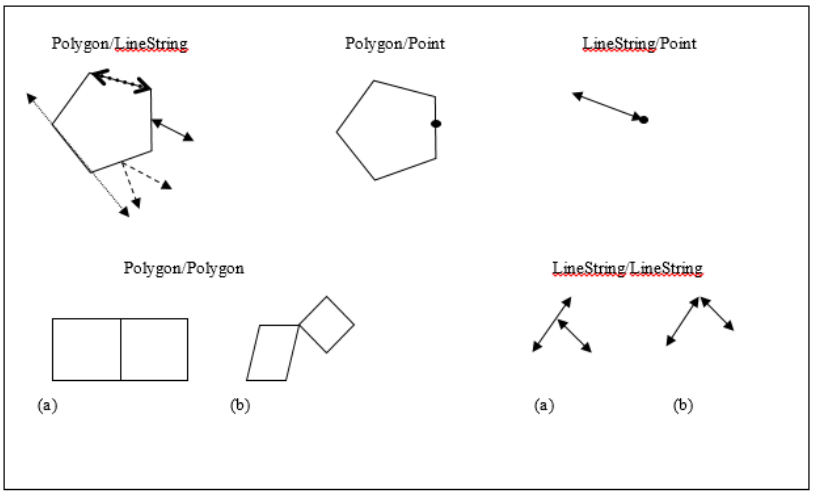
TOUCHES – Geometric object **a** intersects with geometric object **b** but they do not share interior points.
Only the boundary of one geometry intersects with the boundary or interior of another geometry.
The only thing the geometric objects have in common is contained in the union of their boundaries.

The ISO 19125-1 definition of TOUCHES is:

$$\boldsymbol{a}.Touch(\boldsymbol{b}) \Leftrightarrow (I(\boldsymbol{a}) \cap I(\boldsymbol{b}) = \varnothing) \wedge (\boldsymbol{a} \cap \boldsymbol{b}) \neq \varnothing$$

This translates to: **a** touches **b** if the intersection of the interior of **a** and the interior of **b** is the empty set AND the intersection of **a** and **b** is not the empty set.

Note: This operator applies to the Area/Area, Line/Line, Line/Area, Point/Area, and Point/Line relationships. It does not apply to a Point/Point relationship since points do not have a boundary.



Examples of the TOUCHES relationship.

Note the Polygon touches Polygon example (a) is also a case where the Polygon boundaries are COINCIDENT. In the Polygon/LineString example two of the LineStrings that share a linear portion of the Polygon boundary are also COINCIDENT with the Polygon boundary.

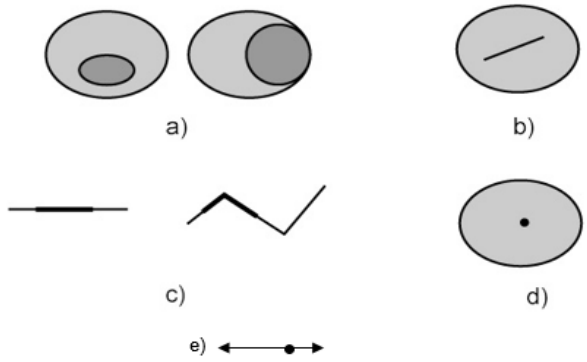
WITHIN – Geometric object **a** is completely contained in geometric object **b**.
WITHIN includes EQUALS.

The definition of WITHIN is:

a. Within(**b**) ⇔ (**a** ∩ **b** = **a**) ∧ (I(**a**) ∩ I(**b**) ≠ ∅)

This translates to: **a** is within **b** if the intersection of **a** and **b** equals **a** AND the intersection of the interior of **a** and the interior of **b** is not the empty set.

Note that this formula matches the one given in **the OpenGIS Simple Features Specification for SQL, Revision 1.1 (OpenGIS Project Document 99-049, Release Date: May 5, 1999**) which is the precursor to ISO 19125-1.



Examples of the WITHIN relationship — Polygon/Polygon (a), Polygon/LineString (b), LineString/LineString (c), Polygon/Point (d), and LineString/Point (e)

Note that a Line that completely falls on a Polygon boundary is not WITHIN the Polygon, it TOUCHES it. In that case it would also be COINCIDENT with the Polygon boundary and COVERED_BY the Polygon.

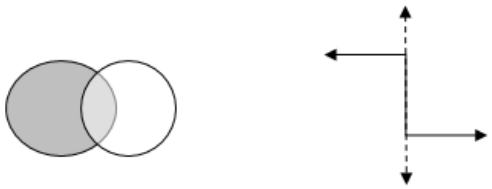
OVERLAPS - The intersection of two geometric objects with the same dimension results in an object of the same dimension but is different from both of them.
For two Polygons or two LineStrings, part of each geometry, but not all, is shared with the other.

The OVERLAPS relationship is defined for Area/Area and Line/Line relationships. Points are either equal or disjoint.
Note that this does not include lines that cross.

The ISO 19125-1 definition of OVERLAPS is:

***a**.Overlaps(**b**) ⇔ (dim(I(**a**)) = dim(I(**b**)) = dim(I(**a**) ∩ I(**b**))) ∧ (**a** ∩ **b** ≠ **a**) ∧ (**a** ∩ **b** ≠ **b**)*

This translates to: **a** OVERLAPS **b** if the geometric dimension of:
(1) the interior of **a**
(2) the interior of **b**
(3) the intersection of the interiors of **a** and **b**
are all equal AND the intersection of **a** and **b** does not equal either **a** or **b**.



Examples of the OVERLAPS relationship

Note Lines that OVERLAP are also COINCIDENT.

CROSSES – The intersection of geometric object **a** and geometric object **b** returns geometry with a dimension less than the largest dimension between **a** and **b** but is not the same as geometric object **a** or **b**.

Two LineStrings cross each other if they meet on an interior point. A LineString crosses a Polygon if the LineString is partly inside the Polygon and partly outside.

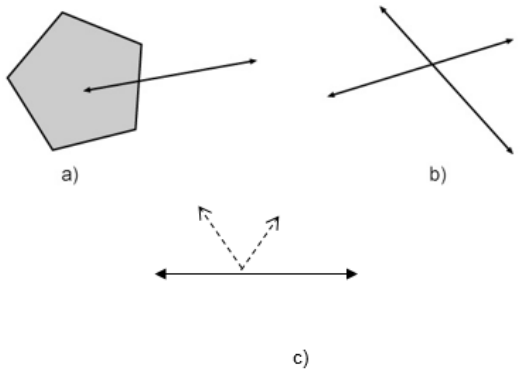
The definition of CROSSES is:

$\mathbf{a}.Cross(\mathbf{b}) \Leftrightarrow (I(\mathbf{a}) \cap I(\mathbf{b}) \neq \emptyset) \wedge (dim(I(\mathbf{a}) \cap I(\mathbf{b})) < max(dim(I(\mathbf{a})), dim(I(\mathbf{b})))) \wedge (\mathbf{a} \cap \mathbf{b} \neq \mathbf{a}) \wedge (\mathbf{a} \cap \mathbf{b} \neq \mathbf{b})$

This translates to: **a** crosses **b** if the intersection of the interiors of **a** and **b** is not the empty set AND the dimension of the result of the intersection of the interiors of **a** and **b** is less than the largest dimension between the interiors of **a** and **b** AND the intersection of **a** and **b** does not equal either **a** or **b**.

Note that "$(I(\mathbf{a}) \cap I(\mathbf{b}) \neq \emptyset) \wedge$ " was added to the beginning of the ISO 19125-1 formula so that it would not be true for disjoint geometry.

The CROSSES operator only applies to Line/Line and Line/Area relationships.



Examples of the CROSSES relationship

Note that example c) shows one solid line and one dashed line – their interiors intersect. If any Line were split into two separate Line features at the intersection point then the relationship would be TOUCHES because a boundary would be involved.

INTERSECTS is the reciprocal of DISJOINT.
The two geometric objects cross, overlap or touch, or one is within (or is contained by) the other. They

have at least one common point.

CONTAINS is the reciprocal of WITHIN.
*Given two geometric objects, **a** and **b**, if **a** is within **b** then **b** must contain **a**.*

COVERED_BY (not a standard ISO 19125-1 operator)

No point of geometry **a** is outside geometry **b**.

The definition of COVERED_BY is:

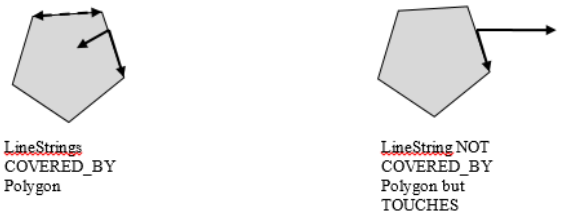
a. COVERED_BY (**b**) ⇔ (**a** ∩ **b** = **a**)

This translates to: **a** is COVERED_BY **b** if the intersection of **a** and **b** equals **a**.

The following expressions are equivalent to **a** is COVERED_BY **b**:

1. Polygon (**a**) is COVERED_BY Polygon (**b**): Polygon **a** is WITHIN a polygon **b** (WITHIN includes EQUALS)
2. Point (**a**) is COVERED_BY Polygon (**b**): Point **a** is WITHIN or TOUCHES polygon **b**
3. Line (**a**) is COVERED_BY Polygon (**b**): Line **a** is WITHIN polygon **b** or WITHIN the boundary of Polygon **b**
4. Line (**a**) is COVERED_BY Line (**b**): Line **a** is WITHIN Line **b** (WITHIN includes EQUALS)
5. Point (**a**) is COVERED_BY Line (**b**): Point **a** is WITHIN or TOUCHES Line **b**
6. Point (**a**) is COVERED_BY Poiint (**b**): Point **a** EQUALS Point **b**

Note that the figure below on the left is an example of Lines that are COVERED_BY a polygon. The figure on the right is NOT an example of a Line that is covered by a Polygon – it is an example of a Line that TOUCHES a Polygon. In both cases the Lines are COINCIDENT with the Polygon boundary.



Examples of COVERED_BY and NOT COVERED_BY

COVERS (not a standard ISO 19125-1 operator)

COVERS is the reciprocal of COVERED_BY.

*Given two geometric objects, **a** and **b**, if **a** is* COVERED_BY ***b** then **b** must cover **a**.*

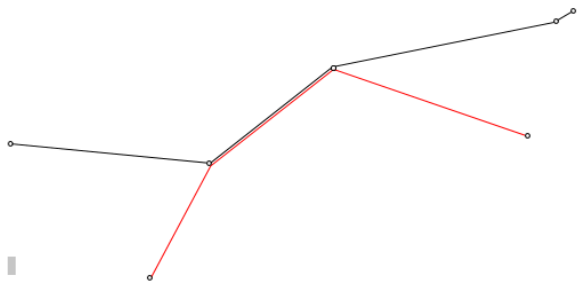
COINCIDENT (not an ISO 19125-1 operator)

Two geometric Lines OVERLAP or one geometric Line is WITHIN the other. Note that EQUAL Lines are also COINCIDENT by this definition.
The intersection of two geometric Lines results in one or more Lines.

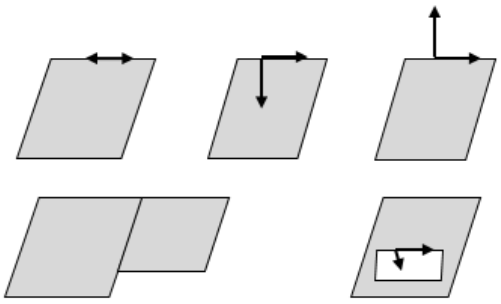
This operator is only to be used to compare a Line with another Line. Note that normally the boundary of a Polygon is not the same as a Line but for this operation the boundary of a Polygon, exterior and interior rings, is treated as Lines for the COINCIDENT test.

The following expressions are equivalent to **a** is COINCIDENT with **b**:

1. Polygon (**a**) is COINCIDENT with Polygon (**b**): The boundary of Polygon **a** OVERLAPS or is WITHIN the boundary of Polygon **b**.
2. Line (**a**) is COINCIDENT WITH Polygon (**b**) : Line **a** OVERLAPS or is WITHIN the boundary of Polygon **b**.
3. Line (**a**) is COINCIDENT WITH Line (**b**): Line **a** OVERLAPS or is WITHIN Line **b**



Example of two COINCIDENT geometric LINES



Examples of COINCIDENT objects

Above are other examples of objects COINCIDENT with the boundary of a Polygon. LineStrings following a portion of a Polygon boundary or Polygons sharing a boundaryportion.
Note that by definition a Line can be COINCIDENT with an interior boundary of a Polygon.
Note that other relationships may also be true, such as COVERED_BY or TOUCHES, since COINCIDENT is not mutually exclusive.

Bibliography

[1] ISO 19125-1:2004, *Geographic Information – Simple feature access – Part 1 Common architecture*

[2] CLEMENTINI, E., DI FELICE, P., VAN OOSTROM, P. *A Small Set of Formal Topological Relationships Suitable for End-User Interaction, in D. Abel and B. C. Ooi (Ed.), Advances in Spatial Databases* — Third International Symposium. SSD 1993. LNCS **692**, pp. 277-295. Springer Verlag. Singapore (1993)

[3] ISO 19107:2003, *Geographic information | Spatial schema*

[4] OpenGIS Simple Features Specification for SQL, Revision 1.1 *(OpenGIS Project Document 99-049, Release Date: May 5, 1999)*

Appendix F. Portrayal Catalogue

Name: Navigational Warnings Portrayal Catalogue
Scope: Navigational Warnings
Version Number: 0.1
Version Date: 2018-06-12
Producer:

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

Language: English

- Comment from Ryan Andresen, Second Officer, Canadian Coast Guard Ship Sir Wilfrid Laurier; The “Map” [NIS website] display has a lot of potential to help us, both at sea and ashore, visually identify hotspots of Navigationally significant information.
  - It would be nice if the NWs plotted on the Map could be subdivided by category (perhaps based on NW Categories? AtoN, Obstructions, Marine Work, etc) and colour coded to provide a better view of the types of NWs in a particular area.

Appendix G. Implementation guide

1. S-124 compliant ECDIS should have a function to generate an electronic report that can be used by the inspector for comparison with the latest in-force NW list from the service website.
2. A function to generate a report that show changes since last update request, e.g. what has been cancelled and what is new.
3.