



IALA S-240 Product Specification

Edition 1.0.0 – October 2020

IALA DGNS Station Almanac Product Specification

Table of Contents

Contents

1	Overview.....	6
1.1	Introduction.....	6
1.2	References	6
1.2.1	Normative References	6
1.2.2	Informative References	6
1.3	Terms, Definitions and abbreviations	7
1.3.1	Terms and definitions.....	7
1.3.2	Acronyms	7
1.4	Product Specification metadata.....	8
1.4.1	IALA Product Specification Maintenance	8
2	Specification Scope	9
3	Data Product Identification.....	10
4	Data Content and structure.....	11
4.1	Introduction.....	11
4.2	Application Schema.....	11
4.3	Feature Catalogue	13
4.3.1	Introduction	13
4.3.2	Feature Types.....	13
4.4	Units of Measure	15
4.5	Geometry.....	16
5	Co-ordinate reference systems (CRS).....	16
5.1	Introduction.....	16
5.2	Horizontal Geodetic Datum.....	16
5.3	Vertical Datum	16
5.4	Units of Measure	16
6	Data Quality	17
6.1	Introduction.....	17
6.2	Quality measure elements.....	17
6.3	Test methods.....	20
6.4	Data quality testing and reporting.....	20

7	Data Capture and classification	21
7.1	Introduction.....	21
7.2	Data Encoding and Product Delivery.....	22
7.2.1	Data Encoding.....	22
7.2.2	Types of Datasets	22
7.2.3	Content of Update Datasets.....	22
7.3	Encoding of Latitude and Longitude	23
7.4	Numeric Attribute Encoding.....	23
7.5	Text Attribute Values	23
7.6	Mandatory Attribute Values	24
7.7	Unknown Attribute Values	24
7.8	Structure of dataset files.....	24
7.9	Object identifiers.....	24
7.10	Data coverage.....	25
7.11	Data overlap.....	25
7.12	Data extent.....	25
8	Data Maintenance.....	25
8.1	Introduction.....	25
8.2	Production process for base and update datasets.....	26
8.3	Dataset updates and cancellation.....	26
8.4	Support file updates.....	26
8.5	Feature and portrayal catalogues.....	26
8.6	Feature history, versions, and change tracking	27
9	Portrayal	27
10	Data Product format (Encoding)	27
11	Data Product delivery	28
11.1	Data Product Delivery Information.....	28
11.1.1	Dataset loading.....	28
11.1.2	New editions.....	29
11.2	Dataset size.....	29
11.3	Exchange Set.....	29
11.4	Support Files	30
11.5	Support File Naming Convention.....	30
11.6	Dataset Naming Convention.....	31

11.7	Update dataset naming convention	31
11.8	Catalogue File Naming Convention	32
12	Metadata.....	32
12.1	Introduction.....	32
12.2	Dataset Metadata	32
12.3	Update and Cancellation Dataset Metadata	35
12.4	Support file Metadata	36
12.5	Exchange Set Metadata	37
12.6	Catalogue File Metadata.	38
ANNEX A	Data classification and Encoding Guide	40
ANNEX B	Validation Check	45
ANNEX C	S-240 GML Schema	51
ANNEX D	S-240 Feature Catalogue.....	62

1 Overview

1.1 Introduction

The DGNSS Station Almanac is a document published and maintained by IALA, which contains information about the worldwide DGNSS stations. The DGNSS Station Almanac Product Specification provides a common structure for the exchange of information about DGNSS stations. The product contains the station name, identification numbers of reference stations and transmitting station, positions, nominal range, operation status, transmitted message types, frequency, bit rate, remarks related to a DGNSS station.

The Product Specification can be used to exchange DGNSS station information in a consistent form between IALA, Lighthouse Authorities, Hydrographic Offices and other organizations (*to include commercial and professional agencies, mariners and manufacturers*). This information can also be provided as a document converted from the dataset

1.2 References

1.2.1 Normative References

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

- IHO S-100 IHO Universal Hydrographic Data Model Edition 4.0.0 (December 2018).
- ISO 3166-1. 1997. *Country Codes*. 1997.
- ISO/TS 19103:2005 Geographic Information - Conceptual schema language
- ISO 19109:2005 Geographic Information - Rules for Application Schema
- ISO 19115:2003+Corr1 (2006) Geographic Information - Metadata
- ISO 19131:2007 Geographic Information - Data product specifications
- ISO 19136:2007 Geographic Information – Geography Markup Language
- ISO/TS 19139, Geographic Information – Metadata – XML schema implementation.

1.2.2 Informative References

The following informative documents provide additional information, including background information, but are not required to develop applications for data conforming to this specification.

- ITU-R M.823-3 Technical characteristics of differential transmissions for global navigation satellite systems from maritime radio beacons in the frequency band 283.5-315 kHz in Region 1 and 285-325 kHz in Region 2 and 3
- RTCM 10402.3 RTCM Recommended Standards for Differential GNSS(Global Navigation Satellite Systems) Service version 2.3.
- IALA Recommendation R-121 On the Performance and Monitoring of DGNSS Services in the Frequency Band 283.5-325 kHz (Ed. 1.1, December 2004)
- IALA 2015. DGNSS Station Almanac.
- IALA 2010. IALA Navguide.
- IALA 2012. International Dictionary of Marine Aids to Navigation.
- ISO/IEC 19757-3, Information technology – Document Schema Definition Languages (DSDL) – Part 3: Rule-based validation – Schematron.

1.3 Terms, Definitions and abbreviations

1.3.1 Terms and definitions

Terms and definitions have been taken from the normative references cited in clause 1.2.1.

1.3.2 Acronyms

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

IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
CRS	Coordinate Reference System
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigational Chart
IHO	International Hydrographic Organization
IMO	International Maritime Organization
DGNSS	Differential Global Navigation Satellite System
WGS84	World Geodetic System 1984
XML	Extensible Markup Language
XSL	
XSD	
UML	Unified Modelling Language
GML	Geography Markup Language
OCG	Open Geospatial Consortium
UTF-8	
EPSG	
GM	

PNG	Portable Network Graphics
SVG	Scalable Vector Graphics
TIFF	Tagged Image File Format

1.4 Product Specification metadata

Title	DGNSS Station Almanac
Version	1.0.0
Identifier	S-240
S-100 version	4.0.0
Date	17 May 2020
Language	English
Classification:	001 - unclassified
Contact:	IALA-AISM 10, rue des Gaudines 78100 Saint Germain en Laye, France Telephone: +33 1 34 51 70 01 Fax: +33 1 34 51 82 05
URL:	http://iala-aism.org
Maintenance:	The product specification is maintained by IALA-AISM and amendments are performed on a needs base, up to maximum one new release per calendar year.

1.4.1 IALA Product Specification Maintenance

This chapter is for clarification only on PS Maintenance.

1.4.1.1 Introduction

Changes to a product specification will be released by IALA-AISM as a new edition, revision, or clarification.

1.4.1.2 New Edition

New editions of a product specification 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.

1.4.1.3 Revisions

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

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

1.4.1.4 Clarification

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

Changes in a clarification are minor and ensure backward compatibility with the previous versions within the same edition. Within the same edition, a data product 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.

1.4.1.5 Version Numbers

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

New editions denoted as **n.0.0**

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

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

2 Specification Scope

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

Scope ID: DGNSS Station Almanac 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

3 Data Product Identification

This clause describes how to identify data sets that conform to the specification. A dataset that conforms to this Product Specification may be identified by its discovery metadata as defined in clause 13 of this specification. The information identifying the data product may include the following items from S-100 4.0.0 clause 11-6 (adapted from ISO 19115-1).

Title	DGNSS Station Almanac
Alternate Title	IALA – DGNSS
Abstract	Name, Identification numbers, positions, operation status of DGNSS stations. Additional general information can also be included.
Topic Category	Environment, Oceans, Structure and Transportation
Geographic Description	Areas specific to marine and inland navigation.
Spatial Extent	Global
Description	DGSS Station information
Spatial Resolution	All scales
Purpose	The purpose of a DGNSS Station Almanac dataset is to exchange name, identification numbers and operation status of DGNSS station. Additional general information can also be included.
Language	English
Spatial Representation Type	Vector (Point)
Point of Contact	IALA
Use Limitation	None

4 Data Content and structure

4.1 Introduction

A DGNSS Station Almanac product is based on the S-100 General Feature Model. A General Feature Model is a meta-model of feature types. A feature may have properties that may be operations, attributes or associations. Any feature may have a number of attributes. A feature is not defined in terms of a single geometry, but rather as a conceptually meaningful object within a particular domain, one or more of whose properties may be geometric. The 'Feature' is the fundamental unit of geospatial information, so the Feature Model is the fundamental meta-model used for developing an Application Schema.

The following sub-sections contain the product application schema expressed in UML and an associated feature catalogue. The feature catalogue provides a full description of each feature type including its attributes and attribute values in the data product.

4.2 Application Schema

The UML model shown in Figure 4.1 below illustrates an application schema of DGNSS Station Almanac. It includes a general description of elements used to construct the application schema, and the relationships between them. These elements include feature types, information types, simple attributes, complex attributes, aggregations and associations.

A brief description of these is provided below and the full description is included in the feature catalogue.

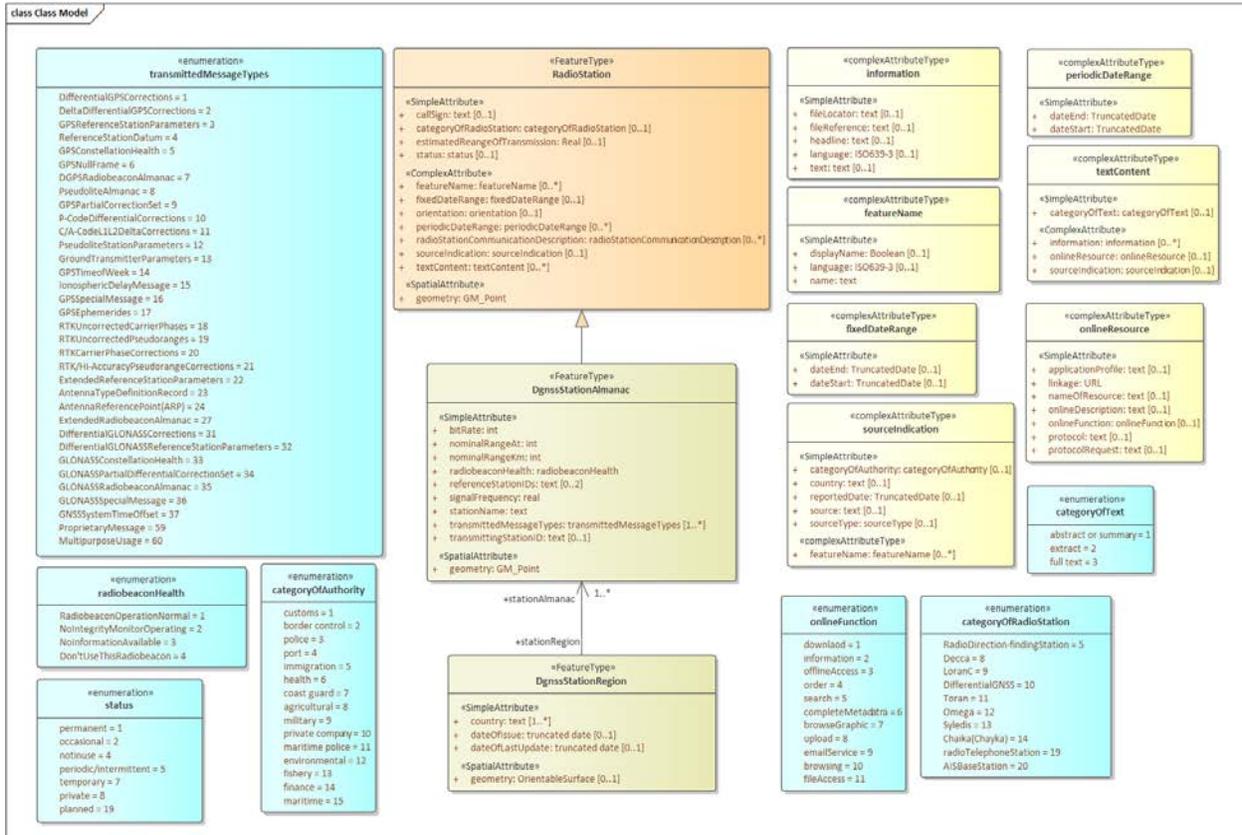
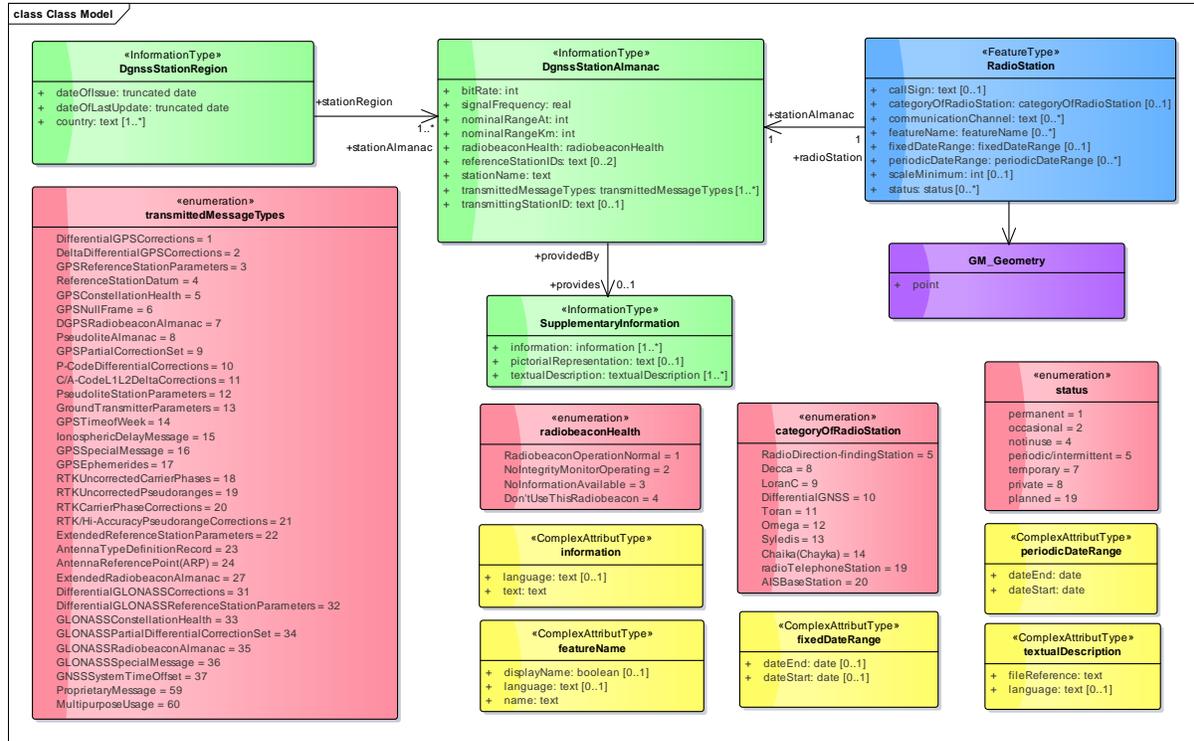


Figure 1. Application Schema of DGNS Station Almanac

A feature is an abstraction of real world phenomena. A certain feature type is the class used to describe all instances of that kind of real world object. In object-oriented modelling, feature types are equivalent to classes and feature instances are equivalent to objects.

An information type is an identifiable object that can be associated with features in order to carry information pertaining to the associated features.

Simple attributes can be enumerations, code lists or simple types (e.g. integer or character string).

Complex attributes are properties of a feature which can be divided into multiple sub attributes and are used where objects have properties that better fit a hierarchical structure. They provide a better construct for encoding list attributes on objects such as light sectors.

An association is a relationship that links instances of one feature or information type with instances of the same or different feature and information types. Each relationship has a name and two roles thus giving a more detailed representation of the real world relationships within the dataset.

4.3 Feature Catalogue

4.3.1 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-240 Feature Catalogue is available in an XML document which conforms to the S-100 XML Feature Catalogue Schema. A Feature Catalogue in XML format shall be available from IALA with an accompanying XSL Stylesheet.

Name:	DGNSS Station Almanac Feature Catalogue
Scope:	Ocean, Coastal, Ports, Harbors and Inland waters
Version Number	1.0.0
Field of application:	
Version Date:	2020-05-17
Producer:	IALA 10, rue des Gaudines 78100 Saint Germain en Laye, France Telephone: +33 1 34 51 70 01, Fax: +33 1 34 51 82 05 URL : https://www.iala-aism.org
Language	English

4.3.2 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.

4.3.2.1 Geographic

Geographic (Geo) feature types carries the descriptive characteristics of a real-world entity.

4.3.2.2 Meta

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

4.3.2.3 Feature Relationship

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

4.3.2.4 Information Types

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

4.3.2.5 Attributes

S-240 defines attribute as either simple or complex. Attributes guideline is shown below:

Numeric Attribute Values

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

Text Attribute Values

Character strings must be encoded using the character set specified in Unicode Transformation Format-8 (UTF-8).

Mandatory Attribute Values

Where attributes determine the display of a Feature, or are essential to the overall feature type construction they may be mandatory. All mandatory attributes are identified in the feature catalogue.

S-240 uses several types of simple attributes; they are listed in the following table:

Table 1. Simple feature attributes

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.
CharacterString	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 (YYYYMMDD)
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.

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

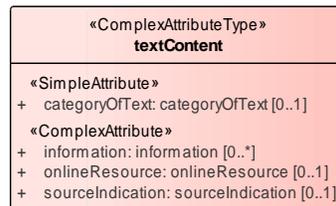


Figure 2. textContent - a complex attribute

4.4 Units of Measure

The following units of measure is used in DGNSS Station Almanac datasets;

- Orientation is given in decimal degrees
- Radio frequency is given in hertz
- Uncertainty is given in metres
- Distances are given in metres or nautical miles

4.5 Geometry

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.

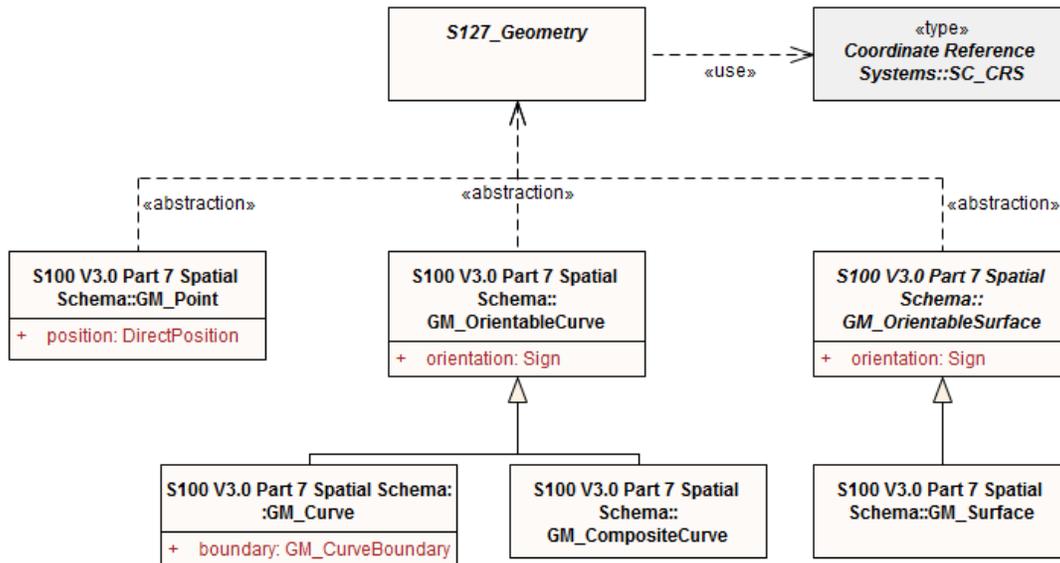


Figure 3. Geometric primitives

5 Co-ordinate reference systems (CRS)

5.1 Introduction

The single coordinate reference system is separated into the horizontal and vertical components.

5.2 Horizontal Geodetic Datum

WGS84 (World Geodetic System of 1984) must be used for the horizontal reference system for spatial data. WGS84 must be used as the reference ellipsoid.

5.3 Vertical Datum

Vertical datum shall be selected from the list in verticalDatum enumeration. If the local datum value is used, additional information must be provided using the comment attribute in the metadata, or information attribute on the feature instance. Positive value is above vertical datum and negative is below vertical datum.

5.4 Units of Measure

Units of measure for S-240 datasets must be as follows,

For height, depth and vertical length it must be metres.
 For range it must be nautical miles
 For orientation it must be degrees
 For signal duration it must be seconds
 For audible signal output it must be decibel
 For signal frequency it must be Hertz

6 Data Quality

6.1 Introduction

Data quality allows users and user systems to assess fitness for use of the provided data. Data quality measures and the associated evaluation are reported as metadata of a data product. This metadata improves interoperability with other data products and provides usage by user groups that the data product was not originally intended for. The secondary users can make assessments of the data product usefulness in their application based on the reported data quality measures.

For S-240 the following data quality elements have been included:

- Conformance to this Product Specification;
- Intended purpose of the data product;
- Completeness of the data product in terms of coverage;
- Logical Consistency;
- Positional Uncertainty and Accuracy;
- Thematic Accuracy;
- Temporal Quality;
- Aggregation measures;
- Elements specifically required for the data product;
- Validation checks or conformance checks including:
 - General tests for dataset integrity;
 - Specific tests for a specific data model;

6.2 Quality measure elements

The recommended data quality measures and their applicability in S-240 are indicated in the table below. NA indicated the measure is not applicable. This table reproduces the first 4 columns of the data quality checklist recommended elements and replaces the final column with descriptions of the scope of the element in the context of S-240 datasets.

Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-240

Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-240
Completeness / Commission	Excess data present in a dataset, as described by the scope.	numberOfExcessItems / This data quality measure indicates the number of items in the dataset, that should not have been present in the dataset.	dataset/dataset series	All features and info types
Completeness / Commission	Excess data present in a dataset, as described by the scope.	numberOfDuplicateFeatureInstances / This data quality measure indicates the total number of exact duplications of feature instances within the data.	dataset/dataset series	All features and info types
Completeness / Omission	Data absent from the dataset, as described by the scope.	numberOfMissingItems / This data quality measure is an indicator that shows that a specific item is missing in the data.	dataset/dataset series/spatial object type	All features and info types
Logical Consistency / Conceptual Consistency	Adherence to the rules of a conceptual schema.	numberOfInvalidSurfaceOverlaps / This data quality measure is a count of the total number of erroneous overlaps within the data. Which surfaces may overlap and which must not is application dependent. Not all overlapping surfaces are necessarily erroneous.	spatial object / spatial object type	Features with surface geometry; spatial objects of type surface
Logical Consistency / Domain Consistency	Adherence of the values to the value domains.	numberOfNonconformantItems / This data quality measure is a count of all items in the dataset that are not in conformance with their value domain.	spatial object / spatial object type	All features and info types
Logical Consistency / Format Consistency	Degree to which data is stored in accordance with the physical structure of the data set, as described by the scope	physicalStructureConflictsNumber / This data quality measure is a count of all items in the dataset that are stored in conflict with the physical structure of the dataset.	dataset/dataset series	All features and info types
Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	rateOfFaultyPointCurveConnections / This data quality measure indicates the number of faulty link-node connections in relation to the number of supposed link-node connections. This data quality measure gives the erroneous point-curve connections in relation to the total number of point-curve connections.	spatial object / spatial object type	Features with curve geometry; spatial objects of curve types
Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfMissingConnectionsUndershoots / This data quality measure is a count of items in the dataset within the parameter tolerance that are mismatched due to undershoots.	spatial object / spatial object type	Features with curve geometry; spatial objects of curve types

Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-240
Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfMissingConnectionsOvershoots / This data quality measure is a count of items in the dataset within the parameter tolerance that are mismatched due to overshoots.	spatial object / spatial object type	Features with curve geometry; spatial objects of curve types
Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfInvalidSlivers / This data quality measure is a count of all items in the dataset that are invalid sliver surfaces. A sliver is an unintended area that occurs when adjacent surfaces are not digitized properly. The borders of the adjacent surfaces may unintentionally gap or overlap to cause a topological error.	dataset / dataset series	Features with surface geometry; spatial objects of type surface
Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfInvalidSelfIntersects / This data quality measure is a count of all items in the dataset that illegally intersect with themselves.	spatial object / spatial object type	Features with surface geometry; spatial objects of type surface or curve
Logical Consistency / Topological Consistency	Correctness of the explicitly encoded topological characteristics of the dataset, as described by the scope.	numberOfInvalidSelfOverlap / This data quality measure is a count of all items in the dataset that illegally self-overlap.	spatial object / spatial object type	Features with surface geometry; spatial objects of type surface or curve
Positional Accuracy / Absolute or External Accuracy	Closeness of reported coordinative values to values accepted as or being true.	Root Mean Square Error / Standard deviation, where the true value is not estimated from the observations but known a priori.	spatial object / spatial object type	objects that have coordinative values associated.
Positional Accuracy / Vertical Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	linearMapAccuracy2Sigma / Half length of the interval defined by an upper and lower limit in which the true value lies with probability 95%.	spatial object / spatial object type	objects that have a vertical coordinate values associated.
Positional Accuracy / Horizontal Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	linearMapAccuracy2Sigma / Half length of the interval defined by an upper and lower limit in which the true value lies with probability 95%.	spatial object / spatial object type	objects that have a horizontal coordinate values associated.
Positional Accuracy / Gridded Data Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	Root mean square error of planimetry / Radius of a circle around the given point, in which the true value lies with probability P.	spatial object / spatial object type	NA. S-240 does not have features with gridded geometry

Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Scope in S-240
Temporal Quality / Temporal Consistency	Consistency with time.	Correctness of ordered events or sequences, if reported.	dataset/dataset series/spatial object type	Features with time intervals, fixed/periodic date ranges, schedules.
Thematic Accuracy / ThematicClassificationCorrectness	Comparison of the classes assigned to features or their attributes to a universe of discourse.	miscalculationRate / This data quality measure indicates the number of incorrectly classified features in relation to the number of features that are supposed to be there. [Adapted from ISO 19157] This is a RATE which is a ratio, and is expressed as a REAL number representing the rational fraction corresponding to the numerator and denominator of the ratio. For example, if there are 1 items that are classified incorrectly and there are 100 of the items in the dataset then the ratio is 1/100 and the reported rate = 0.01.	dataset/dataset series/spatial object type	All features and info types
Aggregation Measures / AggregationMeasures	In a data product specification, several requirements are set up for a product to conform to the specification.	DataProductSpecificationPassed / This data quality measure is a boolean indicating that all requirements in the referred data product specification are fulfilled.	dataset/dataset series/spatial object type	Dataset as a whole
Aggregation Measures / AggregationMeasures	In a data product specification, several requirements are set up for a product to conform to the specification.	DataProductSpecificationFailRate / This data quality measure is a number indicating the number of data product specification requirements that are not fulfilled by the current product/dataset in relation to the total number of data product specification requirements.	dataset/dataset series/spatial object type	Dataset as a whole

6.3 Test methods

Define (or provide a pointer to) testing methods for each element in the table. Some test methods may just reference Annex B (Validation Checks) with the direction to report the number of instances in the dataset which fail the checks for that quality element.

6.4 Data quality testing and reporting

S-240 products must be tested with the S-240 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 Annex B.

Production and certification processes for S-240 data should include a standalone quality report which provides full information on the original results (with evaluation procedures and measures applied).

The dataset or exchange set metadata that is distributed with the exchange set may describe only the aggregated result with a reference to the original results described in the standalone quality report. The aggregated Data Quality result provides an indication if the dataset has passed conformance to the Data Product Specification.

Data Quality Measure Aggregation results should be included to indicate if the dataset/dataset series have passed the Product Specifications. The elements which must be included are described in the table below.

Table 2. Elements of data quality aggregated report (extract from DQWG checklist)

Data quality element and sub element	Definition	DQ measure / description	Evaluation scope	Applicable to spatial representation types
Aggregation Measures / AggregationMeasures	In a data product specification, several requirements are set up for a product to conform to the specification.	DataProductSpecificationPassed / This data quality measure is a boolean indicating that all requirements in the referred data product specification are fulfilled.	dataset	All features and information types of the dataset
Aggregation Measures / AggregationMeasures	In a data product specification, several requirements are set up for a product to conform to the specification.	DataProductSpecificationFailRate / This data quality measure is a number indicating the number of data product specification requirements that are not fulfilled by the current product/dataset in relation to the total number of data product specification requirements.	dataset	All features and information types of the dataset

7 Data Capture and classification

7.1 Introduction

S-240 products must be based on data sources released by an appropriate DGNSS Station Almanac defining authority. Data source must be described in each data product.

The production process used to generate DGNSS Station Almanac products may be described in the dataset metadata.

Table 3. Data capture information

Item Name	Description	Multiplicity	Type
dataSource	Identification of the kinds of data sources usable to product datasets compliant with the considering specification	0..*	CharacterString

productionProcess	Link to a textual description of the production process (including encoding guide) applicable to the datasets compliant with the considering specification	0..*	CharacterString (URL)
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7.2 Data Encoding and Product Delivery

7.2.1 Data Encoding

The principal encoding will be the Open Geospatial Consortium (OGC), Geography Markup Language (GML) format. 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.

7.2.2 Types of Datasets

A dataset is a grouping of features, attributes, geometry and metadata which comprises a specific coverage. The following types of S-240 dataset may be produced and contained within an exchange set:

Table 4. DGNSS Station Almanac dataset types

Dataset	Explanations
New dataset (base dataset):	Data for an area different (in coverage and/or extent) to existing datasets.
New Edition of a dataset:	A re-issue plus new information which has not been previously distributed by Updates. Each New Edition of a dataset must have the same name as the dataset that it replaces and should have the same spatial extents. The edition number in the dataset discovery metadata shall increment up by one from the previous edition.
Update dataset	A delta change of the latest edition of a dataset. If there are more than one update dataset, the subsequent update will be a delta of the base dataset + earlier update datasets.
Cancellation	Used to cancel dataset.

7.2.3 Content of Update Datasets

Update datasets can only contain replacements, deletions and additions of whole feature instances or information instances. This means that when a feature or information instance is updated, the new version must contain all the attributes of the old instance, including any inline spatial attributes (i.e., inline geometry), except those attributes that are being removed.

An association to an instance of a feature or information type is treated as an attribute of the referring instance, and therefore adding or deleting an association means the original referring instance must be replaced with a new version. The instance at the other end of the association needs to be replaced if and only if it contains a reference to the first instance.

Spatial objects that are not inline (i.e., geometry that is encoded as an independent spatial object in the dataset) is treated like any other object, i.e., it needs to be updated if and only if the primitive has changed (e.g., a coordinate is updated).

Feature and information type instances are deleted without replacement by setting the `fixedDateRange.dateEnd` attribute of the instance to the date of deletion, which will usually be the issue date of the update.

7.3 Encoding of Latitude and Longitude

Values of latitude and longitude must be accurate to 7 decimal places. Coordinates must be encoded as decimals in the format described below. The encoding is indicated by multiplication factor fields defined in the dataset identification record.

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., 7 digits after the decimal point.

The decimal point must be indicated by the “.” character.

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 $X = \text{longitude} * \text{coordMultFactorX}$
 $= 42.0000 * 1 = 42.0000000$.

7.4 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.

7.5 Text Attribute Values

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

7.6 Mandatory Attribute Values

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

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

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

7.7 Unknown Attribute Values

When a mandatory attribute code or tag is present but the attribute value is missing, it means that the producer wishes to indicate that this attribute value is unknown.

Missing mandatory attributes must be “nilled” .

Optional attributes must be omitted altogether if the value is unknown or missing. They must not be “nilled.”

7.8 Structure of dataset files

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

Dataset Identification Information

Dataset structure information

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.)

Meta features

Geo features

7.9 Object identifiers

The “name” of feature records must provide a unique world-wide identifier of feature records. The “name” of the record is the combination of the subfields **agency**, **featureObjectIdentifier**, and **featureIdentificationSubdivision** elements of the **featureObjectIdentifier** element of the object.

Features, information types, collection objects, meta features, and geometries (inline or external) 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.

7.10 Data coverage

All areas of a dataset must be covered by a DataCoverage meta feature.

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

7.11 Data overlap

S-240 datasets shall not overlap other S-240 datasets.

7.12 Data extent

Datasets must not cross the 180° meridian of longitude

8 Data Maintenance

8.1 Introduction

Datasets are maintained as needed and must include mechanisms for DGNSS Station Almanac updating. Data updates will be made by new editions. The maintenance and update frequency of DGNSS Station Almanac datasets should be defined by the producers (official national authority) implementing this specification.

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

The data product shall provide information on how the data is maintained and should describe the principles and criteria applied in maintenance regime. This should specify the expected frequency of updates.

Table 5. Maintenance and update frequency

Item Name	Description	Multiplicity	Type
maintenanceAndUpdateFrequency	Frequency with which changes and additions are made to the data product (per update scope)	1..*	MD_MaintenanceInformation (ISO 19115)
dataSource	Identification of the kinds of data sources usable to produce datasets	1..*	LI_Source (ISO 19115)
productionProcess	Textual description of the production process	1..*	LI_ProcessStep (ISO 19115)

	applicable to the datasets (per scope or data source)		
--	---	--	--

8.2 Production process for base and update 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 B.

8.3 Dataset updates and cancellation

The purpose of issue of the dataset is indicated in the “purpose” field of the dataset discovery metadata. In order to terminate a dataset, an update dataset file is created for which the edition number must be set to 0. This convention is only used to cancel a base dataset file.

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

When the dataset is cancelled it must be removed from the system.

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

8.4 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. When a feature or information type pointing to a text, picture or application file is deleted or updated so that it no longer references the file, the system software must check to see whether any other feature or information type references the same file, before that file is deleted.

Updates or deletions of a support file may require concurrent updates to feature or information type instance attributes that depend on the file, e.g., pictorialRepresentation, fileReference and fileLocator attributes.

8.5 Feature and portrayal catalogues

For each new version of the S-240 Product Specification a new feature and portrayal catalogue will be released. The system must be able to manage datasets and their catalogues that are created on different versions of the S-240 product specification.

8.6 Feature history, versions, and change tracking

If applications or production systems require versioning of individual instances of feature or information types, maintenance of histories, or change tracking, the methods for versioning, history management, and change tracking and display are left to the application or production system.

[Version numbers can be indicated in datasets by adding a new 'version' attribute to FeatureType and InformationType', or as instance metadata – simple enough in GML but likely more trouble in other encodings.]

9 Portrayal

A Portrayal Catalogue defines the display rules and symbology which apply to the Features defined in this specification.

The Portrayal Catalogue contains portrayal functions that map features to symbology. It also contains symbol definitions, colour definitions, portrayal parameters and portrayal management concepts such as viewing groups. Each catalogue should include a reference to a portrayal library that contains a set of portrayal rules and a set of portrayal specifications (Table 9.1). This information should be included in the product specification for each identified scope.

Table 6. Portrayal Information

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

10 Data Product format (Encoding)

The principal encoding will be the Open Geospatial Consortium (OGC), Geography Markup Language (GML) format. 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.

Table 7. Data product format

formatName	S-100 GML
version	1.0
characterSet	UTF-8
specification	S-100 GML Profile 1.0

11 Data Product delivery

11.1 Data Product Delivery Information

This data product specification defines GML as the primary format in which S-240 data products are delivered. The delivery format is described by the following items (from ISO 19131:2005): format name, version, specification, language, character set.

Table 8. Data product delivery

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
Character set	DPS_DeliveryInformation.deliveryFormat > DPS_DeliveryFormat.characterSet > MD_CharacterSetCode	004 – utf8

* GML is an XML encoding for the transport and storage of geographic information, including both the geometry and the properties of geographic features, between distributed systems. The XML Schema for the GML application schema is provided in a schema document S240.xsd which imports other schema(s) defining common types. Feature instance shall validate against S240.xsd and conform to all other requirements specified in this data product specification including all constraints not captured in the XML Schema document.

11.1.1 Dataset loading

Datasets must always be loaded in the order of base dataset first, then update datasets in the corrected sequential order. Systems are not to load updates out of order, for example if update 1-5 is present, then 6 is missing, update 7 must not be loaded.

11.1.2 New editions

When a new edition of a dataset is received, the system must replace the previous edition, along with any updates with the new edition of the dataset. Loading of subsequent updates follow the same rule as above.

11.2 Dataset size

S-240 datasets shall not exceed 20MB.

~~Update datasets shall not exceed 500KB.~~

11.3 Exchange Set

Data which conforms to this product specification must be delivered by means of an exchange set.

An exchange set will consist of one or more S-240 datasets. An exchange set may also include one or more support files containing supplementary information encoded in separate files. These are linked to the S-240 dataset features, using the attributes described below. Each exchange set will include a single (XML) catalogue file, S-240 exchange set catalogues conform to S-100 4.0.0 Figure 4a-D-2 without modification, containing discovery metadata for each S240 dataset as well as support files. S-240 Exchange set structure conforms to S-100 4.0.0 Figure 4a-D-3 without modification.

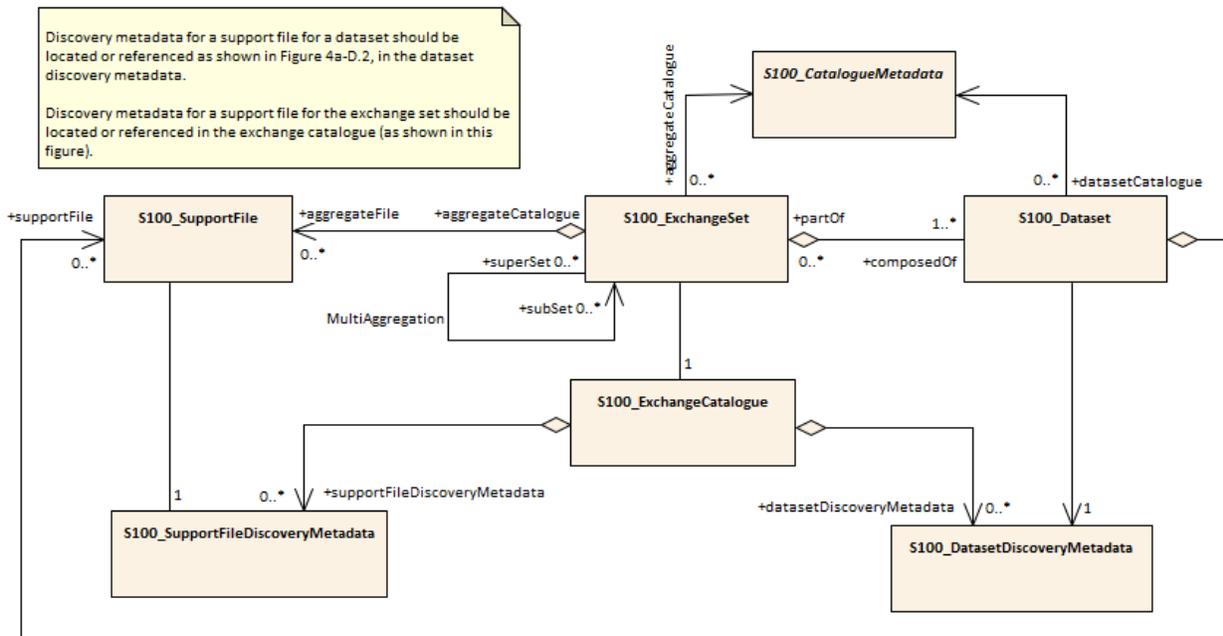


Figure 4. Exchange set structure

11.4 Support Files

Support files contain ancillary textual or graphic information in separate (linked in dataset) files. Information should be encoded in a structured format as defined by W3C. The following formats would be suitable for graphics:

- Portable Network Graphics (PNG) [Edition 2.0]
- Scalable Vector Graphics (SVG) [Edition 1.1]
- Tagged Image File Format (TIFF) [Edition 6.0]
- Joint Photographic Experts Group (JPEG) [Edition 1.02]

Note: PNG is an extensible file format designed for lossless, portable storage of raster images. It provides a patent-free replacement for the GIF format and also replicates many common uses of TIFF. The PNG edition 2 format has been adopted as an ISO standard, (ISO/IEC 15948:2003). SVG is a language for describing two-dimensional graphics in XML [XML10]. SVG allows for three types of graphic objects: vector graphic shapes (e.g., paths consisting of straight lines and curves), images and text. The JPEG standard specifies the codec, which defines how an image is compressed into a stream of bytes and decompressed back into an image, but not the file format used to contain that stream. (The term "JPEG" is an acronym for the Joint Photographic Experts Group, which is the body that created the standard).

11.5 Support File Naming Convention

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

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

CCNNN240XXXXXXXXX.YYY

The main part forms an identifier where:

- the first two characters identify the issuing agency
- the third to fifth characters must be NNN to identify that this is GNSS publication information,
- the sixth to eighth characters must be 240 to identify that this is S-240 DGNSS Station Almanac,
- the ninth up to the sixteenth 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).
- .YYY – support file extension.

11.6 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, replacement and deletion).

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

CCNNN240XXXXXXXXX.GML

The main part forms an identifier where:

- the first two characters identify the issuing agency
- the third to fifth characters must be NNN to identify that this is GNSS publication information,
- the sixth to eighth characters must be 240 to identify that this is S-240 DGNSS Station Almanac,
- the ninth up to the sixteenth 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).

11.7 Update dataset naming convention

All update dataset files will have an identical name to the base dataset, aside from the separator and update number sequence.

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

CCNNN240XXXXXXXXX_XXX.GML

The main part forms an identifier where:

Annex A the first two characters identify the issuing agency

Annex B the third to fifth characters must be NNNI to identify that this is GNSS publication information,

Annex C the sixth to eighth characters must be 240 to identify that this is DGNSS Station Almanac,

Annex D the ninth up to the sixteenth 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).

Annex E The seventeenth character shall be an underscore

Annex F The eighteenth to twentieth characters shall be numerical (0-9 characters to indicate the place of the update dataset in the update sequence.

11.8 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.240.XML. No other file in the exchange set may be named CATALOG.240.XML. The content of the exchange catalogue file is described in Section 14.

12 Metadata

12.1 Introduction

The S-240 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.

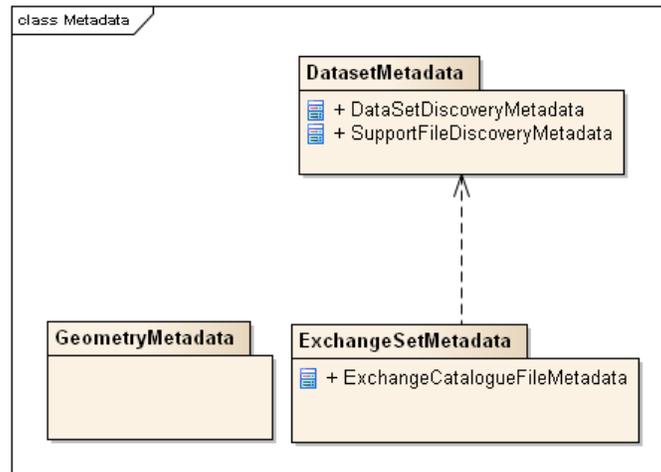


Figure 5. Metadata packages

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.

Note 2: When a dataset is terminated, the purpose metadata field is set to 3 (terminated), and the editionNumber metadata field is set to 0. All other metadata fields must be blank.

12.2 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. Whereas dataset metadata is usually fairly comprehensive, there is also a requirement for a constrained subset of metadata elements that are usually required for discovery purposes. Discovery metadata are

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

Table 9. Dataset metadata

Name	Cardinality	Value	Type	Remarks
S-100_DataSetDiscoveryMetadata				
fileName	1		CharacterString	Dataset file name (see 10.11.6)
filePath	1		CharacterString	Full path from the exchange set root directory
description	1		CharacterString	
dataProtection	0..1	{1} or {2}	CharacterString	1. Encrypted 2. Unencrypted
protectionScheme	0..1		CharacterString	For example S-63
digitalSignature	0..1		CharacterString	
digitalSignatureReference	0..1		CharacterString	
digitalSignatureValue	0..1		CharacterString	
copyright	0..1		MD_LegalConstraints >MD_RestrictionCode <copyright> (ISO 19115)	
classification	0..1		Class MD_SecurityConstraints>MD_ClassificationCode (codelist)	1. unclassified 2. restricted 3. confidential 4. secret 5. top secret
purpose	1	{1}, {2}	CharacterString	1. New dataset 2. New edition
specificUsage	1		MD_USAGE>specificUsage (character string) MD_USAGE>userContactInfo (CI_ResponsibleParty)	brief description of the resource and/or resource series usage
editionNumber	1	{1}	Integer	When a dataset is initially created, the edition number "1" is assigned to it. The edition number is increased by one with each new edition.
issueDate	1		Date	Date on which the dataset was generated.
productSpecification	1	S-240 version N.n	CharacterString	This must be encoded as S240.N.n
producingAgency	1		CI_ResponsibleParty	Party responsible for generating the dataset.
horizontalDatumReference	1	WGS84	CharacterString	EPSG
horizontalDatumValue	1	WGS84	Integer	4326
verticalDatum	1		S100_VerticalAndSoundingDatum	(ignored by applications, not relevant to S-240)

soundingDatum	1	nilled	S100_VerticalAndSoundingDatum	(ignored by applications, not relevant to S-240)
dataType	1	GML	CharacterString	
dataTypeVersion	1	3.2.1	CharacterString	
dataCoverage	1..*		S100_DataCoverage	
comment	0..1		CharacterString	Any additional Information
layerID	1..*	S-101	CharacterString	Dataset must be used with ENC in an ECDIS, ECS, radar ???

12.3 Update and Cancellation Dataset Metadata

Update dataset metadata is intended to describe information about an update dataset. It facilitates the management and exploitation of data and is an important requirement for understanding the characteristics of an update dataset. Whereas dataset metadata is usually fairly comprehensive, metadata for update datasets only describe the issue date and sequential relation to the base dataset.

Table 10. Update dataset metadata

Name	Cardinality	Value	Type	Remarks
S100_DataSetDiscoveryMetadata				
fileName	1		CharacterString	Dataset file name (see 11.7)
filePath	1		CharacterString	Full path from the exchange set root directory
description	1		CharacterString	Brief description of the update.
dataProtection	0..1	{1} or {2}	CharacterString	Value must be same as base dataset.
protectionScheme	0..1		CharacterString	Value must be same as base dataset.
digitalSignature	0..1		CharacterString	
digitalSignatureReference	0..1		CharacterString	
digitalSignatureValue	0..1		CharacterString	
copyright	0..1		MD_LegalConstraints ->MD_RestrictionCode <copyright> (ISO 19115)	Value must be same as base dataset.
classification	0..1		Class MD_SecurityConstraints>MD_ClassificationCode (codelist)	Value must be same as base dataset.
purpose	1	{3}, {4}	CharacterString	3. Update 4. Cancellation
specificUsage	1		MD_USAGE>specificUsage (character string) MD_USAGE>userContactInfo (CI_ResponsibleParty)	brief description of the resource and/or resource series usage

editionNumber	1		Integer	Value must be same as base dataset.
updateNumber	1		CharacterString	Update sequence number, must match file name.
updateApplicationDate	1		Date	Date of update
issueDate	1		Date	Date on which the dataset was generated.
productSpecification	1	S-240 version N.n	CharacterString	Value must be same as base dataset.
producingAgency	1		CI_ResponsibleParty	Party responsible for generating the dataset.
horizontalDatumReference	1	WGS84	CharacterString	EPSG
horizontalDatumValue	1	WGS84	Integer	4326
verticalDatum	1		S100_VerticalAndSoundingDatum	(ignored by applications, not relevant to S-240)
soundingDatum	1	nilled	S100_VerticalAndSoundingDatum	(ignored by applications, not relevant to S-240)
dataType	1	GML	CharacterString	
dataTypeVersion	1	3.2.1	CharacterString	
dataCoverage	1..*		S100_DataCoverage	
comment	0..1		CharacterString	Any additional Information
layerID	1..*	S-240	CharacterString	Value must be same as base dataset.

12.4 Support file Metadata

Support file metadata 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.

Table 11. Support file metadata

Name	Cardinality	Value	Type	Remarks
S100_SupportFileDiscoveryMetadata				
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_SupportFilePu	new, replacement, or deletion.

			rpose	
editionNumber	1		CharacterString	When a dataset is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition. Edition number remains the same for a re-issue
issueDate	1		Date	
supportFileSpecification	1		S100_SupportFileSpecification	
dataType	1		S100_SupportFileFormat	
otherDataTypeDescription	0..1		CharacterString	
dataTypeVersion	1		CharacterString	
comment	0..1		CharacterString	
digitalSignatureReference	0..1		CharacterString	Reference to the appropriate digital signature algorithm
digitalSignatureValue	0..1		CharacterString	

12.5 Exchange Set Metadata

Frequently datasets are packaged and distributed as composite exchange sets by third party vendors. An exchange set could contain many different types of 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.

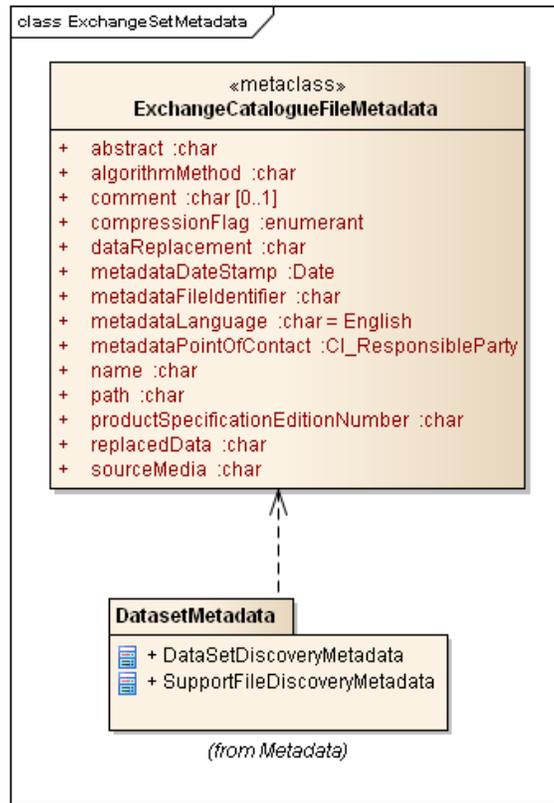


Figure 6. Exchange set metadata

12.6 Catalogue File Metadata.

All S-240 Catalogue metadata files must contain at least the following metadata elements.

Table 12. Catalogue file metadata

Name	Cardinality	Value	Type	Remarks
S100_ExchangeCatalogue				
identifier	1		S100_CatalogueIdentifier	
contact	1		S100_CataloguePointOfContact	
productSpecification	0..1		S100_ProductSpecification	Conditional on all the datasets using the same product specification
metadataLanguage	1..2	English, French	CharacterString	All datasets conforming to this PS must use English language. The catalogue file must be in English with the optional addition of French.
exchangeCatalogueName	1	CATALOG.240.XML	CharacterString	Catalogue filename

exchangeCatalogueDescription	1		CharacterString	
exchangeCatalogueComment	0..1		CharacterString	Any additional Information
compressionFlag	0..1		Boolean	Yes or No
algorithmMethod	0..1		CharacterString	For example. RAR or ZIP
sourceMedia	0..1		CharacterString	
replacedData	0..1		Boolean	
dataReplacement	0..1		CharacterString	

ANNEX A Data classification and Encoding Guide

Definition: DGNSS STATION REGION Information about a region that each DGNSS station is located			
S-240 Information Feature: DgnssStationRegion			
Primitives: None			
<i>Real World</i>	<i>Paper Chart Symbol</i>	<i>ECDIS Symbol</i>	
S-240 Attribute	Allowable Encoding Value	Type	Multiplicity
Date of issue		(S) DA	1,1
Date of last update		(S) DA	1,1
country		(S) TE	1,*
Encoding Guide			

Definition: DGNSS STATION ALMANAC Information about each DGNSS station			
S-240 Information Feature: DGNSSStationAlmanac			
Primitives: None			
<i>Real World</i>	<i>Paper Chart Symbol</i>	<i>ECDIS Symbol</i>	
S-240 Attribute	Allowable Encoding Value	Type	Multiplicity
Bit rate		IN	1,1
Signal Frequency		RE	1,1
Nominal Range At		IN	1,1
Nominal Range Km		IN	1,1
Radiobeacon Health	1 : Radio Beacon Operation Normal 2 : No Integrity Monitor Operating 3 : No Information Available 4 : Don't Use This Radio Beacon	EN	1,1
Reference Station IDs		(S) TE	0,2
Station Name		(S) TE	1,1
Transmitted Messages Types	1 : Differential GPS Corrections 2 : Delta Differential GPS Corrections 3 : GPS Reference Station Parameters 4 : Reference Station Datum 5 : GPS Constellation Health 6 : GPS Null Frame 7 : DGPS Radio beacon Almanac 8 : Pseudolite Almanac 9 : GPS Partial Correction Set 10 : P-Code Differential Corrections 11 : C/A-Code L1L2 Delta Corrections 12 : Pseudolite Station Parameters 13 : Ground Transmitter Parameters 14 : GPS Time of Week 15 : Ionospheric Delay Message 16 : GPS Special Message 17 : GPS Ephemerides 18 : RTK Uncorrected Carrier Phases 19 : RTK Uncorrected Pseudoranges 20 : RTK Carrier Phase Corrections 21 : RTK/Hi-Accuracy Pseudo range Corrections 22 : Extended Reference Station Parameters	EN	1,*

	23 : Antenna Type Definition Record 24 : Antenna Reference Point(ARP) 27 : Extended Radio beacon Almanac 31 : Differential GLONASS Corrections 32 : Differential GLONASS Reference Station Parameters 33 : GLONASS Constellation Health 34 : GLONASS Partial Differential Correction Set 35 : GLONASS Radio beacon Almanac 36 : GLONASS Special Message 37 : GNSS System Time Off set 59 : Proprietary Message 60 : Multipurpose Usage		
Transmitting Station ID		(S) TE	0,1
Encoding Guide			

IHO Definition: RADIO STATION. A place equipped to transmit radio waves. Such a station may be either stationary or mobile, and may also be provided with a radio receiver. In British terminology, also called w/t station. (IHO Dictionary – S-32).			
S-240 Geo Feature: Radio station (RDOSTA)			
Primitives: Point			
<i>Real World</i>	<i>Paper Chart Symbol</i>	<i>ECDIS Symbol</i>	
S-101 Attribute	Allowable Encoding Value	Type	Multiplicity
Call sign		TE	0,1
Category of radio station	5 : radio direction-finding station 8 : Decca 9 : Loran C 10 : Differential GNSS 11 : Toran 12 : Omega 13 : Syledis 14 : Chaika (Chayka) 15 : radio telephone station 16 : AIS base station	EN	0,1
Communication channel		TE	0,*
Estimated range		RE	0,1
Feature name		C	0,*
Display name		(S) BO	0,1
Language	ISO 639-3	(S) TE	0,1
Name		(S) TE	1,1
Fixed date range		C	0,1
Date end	ISO 8601:1988	(S) DA	0,1
Date start	ISO 8601:1988	(S) DA	0,1
Periodic date range		C	0,*
Date end	ISO 8601:1988	(S) DA	1,1
Date start	ISO 8601:1988	(S) DA	1,1
Signal frequency		IN	0,1
Status	1 : permanent 2 : occasional 4 : not in use 5 : periodic/intermittent 7 : temporary 8 : private	EN	0,*
Scale minimum	See clause X.X	IN	0,1
INT 1 Reference: S 10-16			

Radio stations (see S-4 – B-480-484)

Transmissions from radio stations may provide mariners with a line of position. Most radio position fixing systems require Radio Direction Finding (RDF) equipment to determine the bearing of the transmitting device; such equipment is generally no longer fitted on vessels. The exception is “emergency use only” VHF-based direction finding services (which do not use RDF equipment. Consequently, the following radio position-fixing stations are now obsolete and there is no longer any value in encoding them on ENC’s:

- Circular (non-directional) (RC), directional (RD) and rotating pattern (RW) marine radiobeacons;
- Consol beacons (Consol);
- Aeronautical radiobeacons (Aero RC);
- Radio direction-finding stations (except VHF-based emergency stations) (RG);
- Coast Radio Stations providing ‘QTG’ service (R).

The feature “radio station” is used to encode the point of transmission of the signal.

If it is required to encode a radio station, it must be done using the feature **Radio Station**.

Remarks:

- The **Radio Station** must only be used to encode the technical equipment itself, independent of the building or structure in which it is installed. If it is required to encode the building or structure (e.g. mast, tower, radar dome), it must be done using an appropriate feature (e.g. **Building, Landmark**).
- Further information (e.g. transmission characteristic) may be encoded using complex attributes **information** or **textual description**.
- Each VHF-channel should be indicated, using the attribute **communication channel**
- If it is required to encode a DGPS station, it must be done using **Radio Station**, with attribute **category of radio station** = 10 (Differential GNSS).
- Where required, the attribute **signal frequency** must be quoted in Hertz, e.g. a signal frequency of 950 MHz must be encoded as *950000000*.

Radio direction-finding stations (see S-4 – B-483)

If it is required to encode a radio direction-finding station, it must be done using a **Radio Station** feature, with attribute **category of radio station** = 5 (radio direction-finding station). The identification signal may be encoded using the attribute **call sign**.

Remarks:

- Direction-finding is now only provided as an emergency service by VHF.

Distinction: Radar station; radio calling-in point.

ANNEX B Validation Check

1. References

IHO S-58 ENC VALIDATION CHECKS Edition 6.0.0 – 2016
[IHO data quality checklist to be added after it gets a formal document number.]

2. Abbreviation

PS – Product Specification
DCEG – Data Capture and Encoding Guide

3. Production validation checks for S-240 DGNSS Station Almanac

The following checks are intended for production systems designed to produce S-240 DGNSS Station Almanac 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-240 datasets, it is considered premature to classify any checks as error or critical error at this time.

3.1 Check Classification

C	Critical Error	An error which would make a S-240 dataset unusable in application system
E	Error	An error which may degrade the quality of the S-240 dataset through appearance or usability
W	Warning	An error which may be duplication or an inconsistency which will not noticeably degrade the usability of an S-240 dataset

3.1.1 Check application

B	Base	Apply check to new dataset, new edition, and post-update dataset (after updates have been applied to the base).
U	Update	Apply check to update datasets in isolation.
S	Post-update	Apply check only to a post-update dataset, i.e., subsequent to application of all available updates.

Checks do not apply to dataset terminations or cancellations, except where the check description explicitly states it applies in case of a termination or cancellation.

3.2 Checks relating to S-240 Product Specification

[This table will be extended with indication of which of the data quality elements applies to each test. The elements are described in Section 9 or the main specification.]

No	Check description	Check message	Check solution	Conformity to:	Apply to
100	For each feature object where its geometry is not COVERED_BY a DataCoverage	Objects fall outside the coverage object.	Ensure objects are not outside of the limits of the cell.		B, S
101	If the cell file size is greater than 20 Megabytes.	The cell is larger than 20Mb in size.	Ensure that the cell is not larger than 20Mb.		B, S
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.		B, U, S
103	If either QualityOfNonbathymetricData or DataCoverage meta objects do not exist within the data set.	Mandatory feature objects are missing.	Include mandatory meta feature objects QualityOfNonbathymetricData or DataCoverage		B, S
104	If any mandatory attributes are not Present.	Mandatory attributes are not encoded	Populate mandatory attributes (If unknown encode attribute with empty value).		B, U
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.	Remove non-significant zeroes.		B, U
106	For each feature object with an attribute value identical to a corresponding attribute of a meta object it is COVERED_BY.	An attribute value of a meta object is duplicated on a geo object.	Remove duplicate value from geo object.	Logical consistency	B, S
107	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	B, U
108	For each role name on associations that is not defined in the feature catalogue	Wrong role used	Use correct role name	Logical consistency	B, U
109	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	B, U
110	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	B, U
111	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	B, U, S

112	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	B, U, S
113	Ensure dataset conformance to the GML schema	Dataset does not conform to the GML schema	Ensure conformance to the GML schema		B, U
114	Ensure all text fields are encoded using UTF-8	Illegal character set used.	Change character encoding to UTF-8		B, U
115	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	B, U
116	For each feature instance where textContent attribute is present, and two or more information subAttributes are present, and the text subattributes are equal	Values for text sub attribute are identical.	Ensure that text subattributes are populated with the correct values.	Logical consistency	B, U
117	For each feature instance where textContent attribute is present, and two or more information subAttributes are present, and the combination of fileReference and fileLocator subattributes are equal	Values for file reference and locator combinations are identical.	Ensure that national language attributes are populated with the correct values.	Logical consistency	B, U
118	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	B, U
119	For each 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	B, U
120	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		B, U
121	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.		B, U
122	For each feature instance that does not OVERLAP OR is WITHIN an area of dataCoverage	Object outside area of coverage.	Remove object or amend coverage.		B, S

123	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	B, U
124	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	B, U
125	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	B, U
126	For each feature instance which is not COVERED_BY the combined coverage of QualityOfNonBathymetricData meta feature instance.	Feature instance not covered by an QualityOfNonBathymetricData instance.	Ensure full coverage of QualityOfNonBathymetricData instance		B, S
127	If the order of the data in a dataset is not correct.	Incorrect data order.	Amend data order.		B, U
128	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	B, U
129	For each feature instance where periodicDateRange 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	B, U
130	For each feature instance where periodicDateRange 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	B, U
131	For each feature instance where periodicDateRange 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	B, U
132	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).		B, U
135	For each instance of a file referenced in the data, and it is not present in the exchange set	File referenced in the dataset is not present in the exchange set	Add file to exchange set or remove reference to file.		B, S
136	For each instance of a dataset, present in the exchange set and that does not have dataset discovery metadata.	Dataset discovery metadata is missing for dataset	Add dataset discovery metadata		B, U

137	For each instance of a support file, present in the exchange set and that does not have support file discovery metadata.	Support file discovery metadata is missing for support file.	Support file discovery metadata		B, U
138	For each file referenced by the catalogue file in the exchange set, and not present in the exchange set	File is missing from exchange set.	Add file to exchange set or remove reference to file.		B, U
140	For each dataset discovery metadata file that does not correspond to the dataset discovery metadata content table.	Dataset discovery metadata file that does not correspond to the dataset discovery metadata content table.	Ensure correct encoding of the discovery metadata file		B, U
141	For each support file discovery metadata file, does not correspond to the support file discovery metadata content table.	Support file discovery metadata file, does not correspond to the support file discovery metadata content table.	Ensure correct encoding of the support file metadata file		B, U
142	For each catalogue file discovery metadata file, does not correspond to the catalogue file discovery metadata content table.	Catalogue file discovery metadata file, does not correspond to the catalogue file discovery metadata content table.	Ensure correct encoding of the catalogue metadata file.		B, U
143	For each fixedDateRange where dateEnd and dateStart are not Null and dateEnd is less than or equal to dateStart.	dateEnd less than dateStart	Amend values of dateEnd or dateStart accordingly.	Logical consistency	B, U
144	For each fixedDateRange where both dateEnd and dateStart are omitted or Null	FixedDateRange not Populated making the attribute meaningless.	Populate at least one of dateEnd or dateStart	Logical consistency	B, U
145	For each fixedDateRange where dateEnd or dateStart is not Null but the year component is not specified.	Year is required in fixedDateRange dates.	Populate year component of dateStart and dateEnd	Logical consistency	B, U
146	For each textContent attribute where both information and onlineResource are missing or null.	TextContent is not Populated with meaningful information.	Populate information or onlineResource.	Logical consistency	B, U

147	For each information attribute where both fileReference and text subattributes are missing or null	Information is not Populated with meaningful information.	Populate fileReference or text attribute.	Logical consistency	B, U
148	For each sourceIndication where the sub-attributes are missing or null	SourceIndication is not populated with meaningful information.	Populate source indication	Logical consistency	B, U
167	If the update dataset file size is greater than 500Kbytes	The update is larger than 500 KB in size.	Ensure that the cell is not larger than 500 Kbytes		U
168	For each update dataset, a base dataset of the same dataset name is not either present on the system, in the same exchange set, or in another exchange set in the collection of exchange sets.	Base dataset not present	Verify that the absence base dataset is not an error.	Logical consistency	U
169	For each update dataset with updateNumber N > 1, the base dataset is present and updates 1 to N-1 are not present on the system, in the exchange set, or in another exchange set on the system.	Preceding updates not present	Obtain and install preceding updates.	Logical consistency	U
170	For each update dataset, without a feature, information type, or support file	Empty update	Add the data or support file or correct the metadata.	Logical consistency	U
171	For each cancellation (termination) of a dataset that does not exist on the system or has already been cancelled	Terminated dataset is not present	Ignore the update	Logical consistency	U
172	For each cancellation (termination) of a dataset where the update exchange set contains a corresponding dataset file	Cancellations cannot contain data objects	Remove the dataset file from the exchange set or correct the metadata	Logical consistency	U

ANNEX C S-240 GML Schema

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:S100="http://www.iho.int/s100gml/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns="http://www.iala-
aism.org/DgnssStationAlmanacSchema" targetNamespace="http://www.iala-
aism.org/DgnssStationAlmanacSchema" elementFormDefault="qualified"
version="0.1">
  <xs:import namespace="http://www.iho.int/s100gml/1.0"
schemaLocation="s100gmlbase.xsd"/>
  <!--<xs:import namespace="http://www.opengis.net/gml/3.2"
schemaLocation="S100_gmlProfile.xsd"/>-->
  <!-- Types for Complex attribute -->
  <xs:complexType name="informationType">
    <xs:annotation>
      <xs:documentation>Information</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="language" type="xs:string" maxOccurs="1"/>
      <xs:element name="text" type="xs:string" minOccurs="1"/>
    </xs:sequence>
  </xs:complexType>
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    <xs:annotation>
      <xs:documentation>Textual Description</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="fileReference" type="xs:string"/>
      <xs:element name="language" type="xs:string" minOccurs="0"
maxOccurs="1"/>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="featureNameType">
    <xs:annotation>
      <xs:documentation>Feature Name</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="displayName" type="xs:boolean"
minOccurs="0" maxOccurs="1"/>
      <xs:element name="language" type="xs:string" minOccurs="0"
maxOccurs="1"/>
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    </xs:sequence>
  </xs:complexType>

```

```

<xs:complexType name="fixedDateRangeType">
  <xs:annotation>
    <xs:documentation>Fixed Date Range</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="dateEnd" type="xs:date" minOccurs="0"
maxOccurs="1"/>
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maxOccurs="1"/>
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maxOccurs="1"/>
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radiobeaconHealth</xs:documentation>
  </xs:annotation>
  <xs:restriction base="xs:string">
    <xs:enumeration value="RadiobeaconOperationNormal">
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    </xs:enumeration>
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    </xs:enumeration>
    <xs:enumeration value="NoInformationAvailable">
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```

```

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    </xs:enumeration>
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  <xs:annotation>
    <xs:documentation>The type of Radio Station</xs:documentation>
  </xs:annotation>
  <xs:restriction base="xs:string">
    <xs:enumeration value="RadioDirection-findingStation">
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  </xs:annotation>
  <xs:restriction base="xs:string">
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    </xs:enumeration>
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      <xs:annotation>
        <xs:appinfo>2</xs:appinfo>
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```

```

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        <xs:appinfo>9</xs:appinfo>
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    </xs:enumeration>
  </xs:restriction>
</xs:simpleType>
<!-- Feature Types -->
<xs:complexType name="RadioStationType">
  <xs:annotation>
    <xs:documentation>Radio Station</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="S100:AbstractFeatureType">
      <xs:sequence>
        <xs:element ref="S100:pointProperty">
          <xs:annotation>
            <xs:documentation>Point
geometry</xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="callSign" type="xs:string"
minOccurs="0" maxOccurs="1"/>
        <xs:element name="categoryOfRadioStation"
type="categoryOfRadioStationType" minOccurs="0" maxOccurs="1"/>
        <xs:element name="estimatedRangeOfTransmission"
type="xs:real" minOccurs="0" maxOccurs="1"/>
        <xs:element name="communicatonChannel"
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        <xs:element name="featureName"
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type="fixedDateRangeType" minOccurs="0" maxOccurs="1"/>
        <xs:element name="periodicDateRange"
type="periodicDateRangeType" minOccurs="0" maxOccurs="unbounded"/>
        <xs:element name="scaleMinimum" type="xs:integer"
minOccurs="0" maxOccurs="1"/>
        <xs:element name="status" type="statusType"
minOccurs="0" maxOccurs="unbounded"/>
        <xs:element name="orientation"
type="orientationType" minOccurs="0" maxOccurs="1"/>

```

```

                <xs:element
name="radioStationCommunicationDescription"
type="radioStationCommunicationDescriptionType" minOccurs="0" maxOccurs="1"/>
                <xs:element name="sourceIndication"
type="sourceIndicationType" minOccurs="0" maxOccurs="1"/>
                <xs:element name="textContent"
type="textContentType" minOccurs="0" maxOccurs="1"/>
            </xs:sequence>
        </xs:extension>
    </xs:complexContent>
</xs:complexType>
<xs:element name="RadioStationType" type="RadioStationTypeType"
abstract="true"/>

    <xs:complexType name="DgnssStationRegionType">
        <xs:annotation>
            <xs:documentation>Information about the DGNSS Station
Region</xs:documentation>
        </xs:annotation>
        <xs:complexContent>
            <xs:extension base="S100:AbstractInformationType">
                <xs:sequence>
                    <xs:element name="country" type="xs:string"
minOccurs="1" maxOccurs="unbounded"/>
                    <xs:element name="dateOfIssue" type="xs:date"/>
                    <xs:element name="dateOfLastUpdate"
type="xs:date"/>
                </xs:sequence>
            </xs:extension>
        </xs:complexContent>
    </xs:complexType>

    <xs:complexType name="DgnssStationAlmanacType">
        <xs:annotation>
            <xs:documentation>Information about the DGNSS Station
Almanac</xs:documentation>
        </xs:annotation>
        <xs:complexContent>
            <xs:extension base="RadioStationTypeType">
                <xs:sequence>
                    <xs:element name="bitRate" type="xs:integer"/>
                    <xs:element name="signalFrequency"
type="xs:float"/>
                    <xs:element name="nominalRangeAt"
type="xs:integer"/>
                </xs:sequence>
            </xs:extension>
        </xs:complexContent>
    </xs:complexType>

```

```

                                <xs:element name="nominalRangeKm"
type="xs:integer"/>
                                <xs:element name="radiobeaconHealth"
type="radiobeaconHealthType"/>
                                <xs:element name="referenceStationID"
type="xs:string" minOccurs="0" maxOccurs="2"/>
                                <xs:element name="stationName" type="xs:string"/>
                                <xs:element name="transmittedMessageType"
type="transmittedMessageTypesType" minOccurs="0" maxOccurs="unbounded"/>
                                <xs:element name="transmittingStationID"
type="xs:string"/>
                                </xs:sequence>
                                </xs:extension>
                                </xs:complexContent>
                                </xs:complexType>

                                <!-- Feature and Information elements -->
                                <xs:element name="DgnssStationRegion" type="DgnssStationRegionType"/>
                                <xs:element name="DgnssStationAlmanac" type="DgnssStationAlmanacType"/>
                                <!-- Dataset structure -->
                                <xs:complexType name="DgnssStationAlmanacBatchType">
                                    <xs:annotation>
                                        <xs:documentation>DGNSS Station Almanac</xs:documentation>
                                    </xs:annotation>
                                    <xs:sequence>
                                        <xs:element ref="DgnssStationRegion" minOccurs="1"
maxOccurs="unbounded"/>
                                        <xs:element ref="DgnssStationAlmanac" minOccurs="1"
maxOccurs="unbounded"/>
                                    </xs:sequence>
                                </xs:complexType>
                                <xs:element name="DgnssStationAlmanacBatch"
type="DgnssStationAlmanacBatchType">
                                    <xs:annotation>
                                        <xs:documentation>DGNSS Station Almanac</xs:documentation>
                                    </xs:annotation>
                                </xs:element>
                                </xs:schema>

```

ANNEX D S-240 Feature Catalogue

```
<?xml version="1.0" encoding="iso-8859-1"?>
<S100FC:S100_FC_FeatureCatalogue xmlns:S100FC="http://www.iho.int/S100FC"
xmlns:S100Base="http://www.iho.int/S100Base"
xmlns:S100CI="http://www.iho.int/S100CI" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:S100FD="http://www.iho.int/S100FD"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.iho.int/S100FC S100FC.xsd">
  <S100FC:name>DGNSS Station Almanac</S100FC:name>
  <S100FC:scope>Global</S100FC:scope>
  <S100FC:fieldOfApplication>Shore Technical
Infrastructure</S100FC:fieldOfApplication>
  <S100FC:versionNumber>0.1</S100FC:versionNumber>
  <S100FC:versionDate>2019-04-09</S100FC:versionDate>
  <S100FC:producer>
    <S100CI:organisationName>IALA</S100CI:organisationName>
    <S100CI:positionName>Member</S100CI:positionName>
    <S100CI:role>originator</S100CI:role>
  </S100FC:producer>
  <S100FC:S100_FC_SimpleAttributes>
    <S100FC:S100_FC_SimpleAttribute>
      <S100FC:name>Bit Rate</S100FC:name>
      <S100FC:definition></S100FC:definition>
      <S100FC:code>bitRate</S100FC:code>
      <S100FC:valueType>int</S100FC:valueType>
    </S100FC:S100_FC_SimpleAttribute>
    <S100FC:S100_FC_SimpleAttribute>
      <S100FC:name>Call sign</S100FC:name>
      <S100FC:definition>The designated call-sign of a radio
station.</S100FC:definition>
      <S100FC:code>callSign</S100FC:code>
      <S100FC:alias>CALSGN</S100FC:alias>
      <S100FC:valueType>text</S100FC:valueType>
    </S100FC:S100_FC_SimpleAttribute>
    <S100FC:S100_FC_SimpleAttribute>
      <S100FC:name>Category of radio station</S100FC:name>
      <S100FC:definition>Classification of radio services offered by a
radio station.</S100FC:definition>
      <S100FC:code>categoryOfRadioStation</S100FC:code>
      <S100FC:remarks>A radiobeacon is a radio transmitter which
emits a distinctive or characteristic signal on which a bearing may be
taken.</S100FC:remarks>
      <S100FC:alias>CATROS</S100FC:alias>
      <S100FC:valueType>enumeration</S100FC:valueType>
```

<S100FC:listedValues>
 <S100FC:listedValue>
 <S100FC:label>radio direction-finding
station</S100FC:label>
 <S100FC:definition>a radio station intended to
determine only the direction of other stations by means of transmission from the
latter.</S100FC:definition>
 <S100FC:code>5</S100FC:code>
</S100FC:listedValue>
 <S100FC:listedValue>
 <S100FC:label>decca</S100FC:label>
 <S100FC:definition>the Decca Navigator System is a
high accuracy, short to medium range radio navigational aid intended for coastal and
landfall navigation.</S100FC:definition>
 <S100FC:code>8</S100FC:code>
</S100FC:listedValue>
 <S100FC:listedValue>
 <S100FC:label>loran C</S100FC:label>
 <S100FC:definition>loran-C is a low frequency
electronic position fixing system using pulsed transmissions at 100
Khz.</S100FC:definition>
 <S100FC:code>9</S100FC:code>
</S100FC:listedValue>
 <S100FC:listedValue>
 <S100FC:label>differential GPS</S100FC:label>
 <S100FC:definition>a radiobeacon transmitting
DGPS correction signals.</S100FC:definition>
 <S100FC:code>10</S100FC:code>
</S100FC:listedValue>
 <S100FC:listedValue>
 <S100FC:label>toran</S100FC:label>
 <S100FC:definition>toran is an electronic position
fixing system used mainly by aircraft.</S100FC:definition>
 <S100FC:code>11</S100FC:code>
</S100FC:listedValue>
 <S100FC:listedValue>
 <S100FC:label>omega</S100FC:label>
 <S100FC:definition>omega is a long-range radio
navigational aid which operates within the VLF frequency band. The system comprises
eight land based stations.</S100FC:definition>
 <S100FC:code>12</S100FC:code>
</S100FC:listedValue>
 <S100FC:listedValue>
 <S100FC:label>syledis</S100FC:label>
 <S100FC:definition>syledis is a ranging position fixing
system operating at 420-450MHz over a range of up to 400Km.</S100FC:definition>

```
<S100FC:code>13</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
  <S100FC:label>chiaka (Chayka)</S100FC:label>
  <S100FC:definition>chiaka is a low frequency
electronic position fixing system using pulsed transmissions at 100
Khz.</S100FC:definition>
  <S100FC:code>14</S100FC:code>
  </S100FC:listedValue>
  <S100FC:listedValue>
    <S100FC:label>radio telephone
station</S100FC:label>
    <S100FC:definition>the equipment needed at one
station to carry on two way voice communication by radio waves
only.</S100FC:definition>
    <S100FC:code>19</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
      <S100FC:label>AIS base station</S100FC:label>
      <S100FC:definition></S100FC:definition>
      <S100FC:code>20</S100FC:code>
      </S100FC:listedValue>
    </S100FC:listedValues>
  </S100FC:S100_FC_SimpleAttribute>
</S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Communication channel</S100FC:name>
  <S100FC:definition>A channel number assigned to a specific radio
frequency, frequencies or frequency band.</S100FC:definition>
  <S100FC:code>communicationChannel</S100FC:code>
  <S100FC:remarks>The expected input is the specific VHF-
Channel. The attribute 'communication channel' encodes the various VHF-channels
used for communication.</S100FC:remarks>
  <S100FC:alias>COMCHA</S100FC:alias>
  <S100FC:valueType>text</S100FC:valueType>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Country</S100FC:name>
  <S100FC:definition></S100FC:definition>
  <S100FC:code>country</S100FC:code>
  <S100FC:valueType>characterstring</S100FC:valueType>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Date end</S100FC:name>
  <S100FC:definition>The latest date on which an object (e.g., a
buoy) will be present.</S100FC:definition>
  <S100FC:code>dateEnd</S100FC:code>
```

<S100FC:remarks>This attribute is to be used to indicate the removal or cancellation of an object at a specific date in the future. See also 'periodic date end' (PEREND).</S100FC:remarks>

<S100FC:alias>DATEND</S100FC:alias>

<S100FC:valueType>text</S100FC:valueType>

</S100FC:S100_FC_SimpleAttribute>

<S100FC:S100_FC_SimpleAttribute>

<S100FC:name>Date of Issue</S100FC:name>

<S100FC:definition></S100FC:definition>

<S100FC:code>dateOfIssue</S100FC:code>

<S100FC:valueType>date</S100FC:valueType>

</S100FC:S100_FC_SimpleAttribute>

<S100FC:S100_FC_SimpleAttribute>

<S100FC:name>Date of Last Update</S100FC:name>

<S100FC:definition></S100FC:definition>

<S100FC:code>dateOfLastUpdate</S100FC:code>

<S100FC:valueType>date</S100FC:valueType>

</S100FC:S100_FC_SimpleAttribute>

<S100FC:S100_FC_SimpleAttribute>

<S100FC:name>Date start</S100FC:name>

<S100FC:definition>The earliest date on which an object (e.g., a buoy) will be present.</S100FC:definition>

<S100FC:code>dateStart</S100FC:code>

<S100FC:remarks>This attribute is to be used to indicate the deployment or implementation of an object at a specific date in the future. See also 'periodic date start' (PERSTA).</S100FC:remarks>

<S100FC:alias>DATSTA</S100FC:alias>

<S100FC:valueType>text</S100FC:valueType>

</S100FC:S100_FC_SimpleAttribute>

<S100FC:S100_FC_SimpleAttribute>

<S100FC:name>Display name</S100FC:name>

<S100FC:definition></S100FC:definition>

<S100FC:code>displayName</S100FC:code>

<S100FC:valueType>boolean</S100FC:valueType>

</S100FC:S100_FC_SimpleAttribute>

<S100FC:S100_FC_SimpleAttribute>

<S100FC:name>Information</S100FC:name>

<S100FC:definition></S100FC:definition>

<S100FC:code>information</S100FC:code>

<S100FC:valueType>text</S100FC:valueType>

</S100FC:S100_FC_SimpleAttribute>

<S100FC:S100_FC_SimpleAttribute>

<S100FC:name>Language</S100FC:name>

<S100FC:definition></S100FC:definition>

<S100FC:code>language</S100FC:code>

<S100FC:valueType>text</S100FC:valueType>

```

</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Name</S100FC:name>
  <S100FC:definition></S100FC:definition>
  <S100FC:code>name</S100FC:code>
  <S100FC:valueType>text</S100FC:valueType>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Nominal Range At</S100FC:name>
  <S100FC:definition></S100FC:definition>
  <S100FC:code>nominalRangeat</S100FC:code>
  <S100FC:valueType>int</S100FC:valueType>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Nominal Range Km</S100FC:name>
  <S100FC:definition></S100FC:definition>
  <S100FC:code>nominalRangeKm</S100FC:code>
  <S100FC:valueType>int</S100FC:valueType>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Pictorial representation</S100FC:name>
  <S100FC:definition>Indicates whether a pictorial representation of
the object is available.</S100FC:definition>
  <S100FC:code>pictorialRepresentation</S100FC:code>
  <S100FC:remarks>The 'pictorial representation' could be a drawing
or a photo. The string encodes the file name of an external graphic file
(pixel/vector).</S100FC:remarks>
  <S100FC:alias>PICREP</S100FC:alias>
  <S100FC:valueType>text</S100FC:valueType>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Radio Beacon Health</S100FC:name>
  <S100FC:definition></S100FC:definition>
  <S100FC:code>radiobeaconhealth</S100FC:code>
  <S100FC:valueType>enumeration</S100FC:valueType>
  <S100FC:listedValues>
    <S100FC:listedValue>
      <S100FC:label>Radio Beacon Operation
Normal</S100FC:label>
      <S100FC:definition></S100FC:definition>
      <S100FC:code>1</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
      <S100FC:label>No Integrity Monitor
Operating</S100FC:label>
      <S100FC:definition></S100FC:definition>
  </S100FC:listedValues>

```

```

                <S100FC:code>2</S100FC:code>
            </S100FC:listedValue>
            <S100FC:listedValue>
                <S100FC:label>No Information
Available</S100FC:label>
                <S100FC:definition></S100FC:definition>
                <S100FC:code>3</S100FC:code>
            </S100FC:listedValue>
            <S100FC:listedValue>
                <S100FC:label>Don't Use This Radio
Beacon</S100FC:label>
                <S100FC:definition></S100FC:definition>
                <S100FC:code>4</S100FC:code>
            </S100FC:listedValue>
        </S100FC:listedValues>
    </S100FC:S100_FC_SimpleAttribute>
    <S100FC:S100_FC_SimpleAttribute>
        <S100FC:name>Reference Station IDs</S100FC:name>
        <S100FC:definition></S100FC:definition>
        <S100FC:code>referenceStationIDs</S100FC:code>
        <S100FC:valueType>text</S100FC:valueType>
    </S100FC:S100_FC_SimpleAttribute>
    <S100FC:S100_FC_SimpleAttribute>
        <S100FC:name>Scale minimum</S100FC:name>
        <S100FC:definition>The minimum scale at which the object may be
used, e.g., for ECDIS presentation.</S100FC:definition>
        <S100FC:code>scaleMinimum</S100FC:code>
        <S100FC:remarks>The modulus of the scale is indicated, that is
1:1 250 000 is encoded as 1250000.</S100FC:remarks>
        <S100FC:alias>SCAMIN</S100FC:alias>
        <S100FC:valueType>integer</S100FC:valueType>
    </S100FC:S100_FC_SimpleAttribute>
    <S100FC:S100_FC_SimpleAttribute>
        <S100FC:name>Signal frequency</S100FC:name>
        <S100FC:definition>The frequency of a
signal.</S100FC:definition>
        <S100FC:code>signalFrequency</S100FC:code>
        <S100FC:alias>SIGFRQ</S100FC:alias>
        <S100FC:valueType>integer</S100FC:valueType>
    </S100FC:S100_FC_SimpleAttribute>
    <S100FC:S100_FC_SimpleAttribute>
        <S100FC:name>Station name</S100FC:name>
        <S100FC:definition></S100FC:definition>
        <S100FC:code>stationName</S100FC:code>
        <S100FC:valueType>text</S100FC:valueType>
    </S100FC:S100_FC_SimpleAttribute>

```

```
<S100FC:S100_FC_SimpleAttribute>
  <S100FC:name>Status</S100FC:name>
  <S100FC:definition>The condition of an object at a given instant in
time</S100FC:definition>
  <S100FC:code>status</S100FC:code>
  <S100FC:alias>STATUS</S100FC:alias>
  <S100FC:valueType>enumeration</S100FC:valueType>
  <S100FC:listedValues>
    <S100FC:listedValue>
      <S100FC:label>permanent</S100FC:label>
      <S100FC:definition>intended to last or function
indefinitely.</S100FC:definition>
      <S100FC:code>1</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
      <S100FC:label>occasional</S100FC:label>
      <S100FC:definition>acting on special occasions
happening irregularly.</S100FC:definition>
      <S100FC:code>2</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
      <S100FC:label>recommended</S100FC:label>
      <S100FC:definition>presented as worthy of
confidence, acceptance, use, etc.</S100FC:definition>
      <S100FC:code>3</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
      <S100FC:label>not in use</S100FC:label>
      <S100FC:definition>no longer used for the purpose
intended disused.</S100FC:definition>
      <S100FC:code>4</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
      <S100FC:label>periodic/intermittent</S100FC:label>
      <S100FC:definition>recurring at
intervals.</S100FC:definition>
      <S100FC:code>5</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
      <S100FC:label>reserved</S100FC:label>
      <S100FC:definition>set apart for some specific
use.</S100FC:definition>
      <S100FC:code>6</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
      <S100FC:label>temporary</S100FC:label>
```

<S100FC:definition>meant to last only for a
time.</S100FC:definition>
<S100FC:code>7</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>private</S100FC:label>
<S100FC:definition>not in public ownership or
operation.</S100FC:definition>
<S100FC:code>8</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>mandatory</S100FC:label>
<S100FC:definition>compulsory
enforced.</S100FC:definition>
<S100FC:code>9</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>extinguished</S100FC:label>
<S100FC:definition>no longer lit</S100FC:definition>
<S100FC:code>11</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>illuminated</S100FC:label>
<S100FC:definition>lit by floodlights, strip lights,
etc.</S100FC:definition>
<S100FC:code>12</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>historic</S100FC:label>
<S100FC:definition>famous in history of historical
interest.</S100FC:definition>
<S100FC:code>13</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>public</S100FC:label>
<S100FC:definition>belonging to, available to, used
or shared by, the community as a whole and not restricted to private
use.</S100FC:definition>
<S100FC:code>14</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>synchronized</S100FC:label>
<S100FC:definition>occur at a time, coincide in point
of time, be contemporary or simultaneous.</S100FC:definition>
<S100FC:code>15</S100FC:code>
</S100FC:listedValue>

<S100FC:listedValue>
 <S100FC:label>watched</S100FC:label>
 <S100FC:definition>looked at or observed over a
period of time especially so as to be aware of any movement or
change.</S100FC:definition>
 <S100FC:code>16</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
 <S100FC:label>un-watched</S100FC:label>
 <S100FC:definition>usually automatic in operation,
without any permanently-stationed personnel to superintend it.</S100FC:definition>
 <S100FC:code>17</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
 <S100FC:label>existence doubtful</S100FC:label>
 <S100FC:definition>an object that has been reported
but has not been definitely determined to exist.</S100FC:definition>
 <S100FC:code>18</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
 <S100FC:label>buoyed</S100FC:label>
 <S100FC:definition></S100FC:definition>
 <S100FC:code>28</S100FC:code>
</S100FC:listedValue>
</S100FC:listedValues>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
 <S100FC:name>Textual description</S100FC:name>
 <S100FC:definition></S100FC:definition>
 <S100FC:code>textualDescription</S100FC:code>
 <S100FC:valueType>text</S100FC:valueType>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
 <S100FC:name>Transmitted Messsage Types</S100FC:name>
 <S100FC:definition></S100FC:definition>
 <S100FC:code>transmittedMessageTypes</S100FC:code>
 <S100FC:valueType>enumeration</S100FC:valueType>
<S100FC:listedValues>
 <S100FC:listedValue>
 <S100FC:label>Differential GPS
Corrections</S100FC:label>
 <S100FC:definition></S100FC:definition>
 <S100FC:code>1</S100FC:code>
 </S100FC:listedValue>
</S100FC:listedValue>

Corrections</S100FC:label> <S100FC:label>Delta Differential GPS
<S100FC:definition></S100FC:definition>
<S100FC:code>2</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>GPS Reference Station

Parameters</S100FC:label> <S100FC:definition></S100FC:definition>
<S100FC:code>3</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>Reference Station

Datum</S100FC:label> <S100FC:definition></S100FC:definition>
<S100FC:code>4</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>GPS Constellation

Health</S100FC:label> <S100FC:definition></S100FC:definition>
<S100FC:code>5</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>GPS Null Frame</S100FC:label>
<S100FC:definition></S100FC:definition>
<S100FC:code>6</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>DGPS Radio beacon

Almanac</S100FC:label> <S100FC:definition></S100FC:definition>
<S100FC:code>7</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>Pseudo Lite

Almanac</S100FC:label> <S100FC:definition></S100FC:definition>
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Set</S100FC:label> <S100FC:definition></S100FC:definition>
<S100FC:code>9</S100FC:code>
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Corrections</S100FC:label>
<S100FC:definition></S100FC:definition>
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Corrections</S100FC:label>
<S100FC:definition></S100FC:definition>
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Parameters</S100FC:label>
<S100FC:definition></S100FC:definition>
<S100FC:code>12</S100FC:code>
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Parameters</S100FC:label>
<S100FC:definition></S100FC:definition>
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<S100FC:definition></S100FC:definition>
<S100FC:code>14</S100FC:code>
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Message</S100FC:label>
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<S100FC:label>GPS Special
Message</S100FC:label>
<S100FC:definition></S100FC:definition>
<S100FC:code>16</S100FC:code>
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<S100FC:label>GPS Ephemerides</S100FC:label>
<S100FC:definition></S100FC:definition>
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</S100FC:label> <S100FC:definition></S100FC:definition>
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ranges</S100FC:label> <S100FC:definition></S100FC:definition>
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Corrections</S100FC:label> <S100FC:definition></S100FC:definition>
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Corrections</S100FC:label> <S100FC:definition></S100FC:definition>
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Parameters</S100FC:label> <S100FC:definition></S100FC:definition>
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Record</S100FC:label> <S100FC:definition></S100FC:definition>
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Point(ARP)</S100FC:label> <S100FC:definition></S100FC:definition>
<S100FC:code>24</S100FC:code>
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Almanac</S100FC:label> <S100FC:definition></S100FC:definition>

<S100FC:code>27</S100FC:code>
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<S100FC:label>Differential GLONASS
Corrections</S100FC:label>
<S100FC:definition></S100FC:definition>
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</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>Differential GLONASS Reference
Station Parameters</S100FC:label>
<S100FC:definition></S100FC:definition>
<S100FC:code>32</S100FC:code>
</S100FC:listedValue>
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<S100FC:label>GLONASS Constellation
Health</S100FC:label>
<S100FC:definition></S100FC:definition>
<S100FC:code>33</S100FC:code>
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Correction Set</S100FC:label>
<S100FC:definition></S100FC:definition>
<S100FC:code>34</S100FC:code>
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<S100FC:label>GLONASS Radio beacon
Almanac</S100FC:label>
<S100FC:definition></S100FC:definition>
<S100FC:code>35</S100FC:code>
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<S100FC:label>GLONASS Special
Message</S100FC:label>
<S100FC:definition></S100FC:definition>
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<S100FC:label>GNSS System Time Off
Set</S100FC:label>
<S100FC:definition></S100FC:definition>
<S100FC:code>37</S100FC:code>
</S100FC:listedValue>
<S100FC:listedValue>
<S100FC:label>Proprietary Message</S100FC:label>

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        <S100FC:definition></S100FC:definition>
        <S100FC:code>59</S100FC:code>
    </S100FC:listedValue>
    <S100FC:listedValue>
        <S100FC:label>Multi purpose Usage</S100FC:label>
        <S100FC:definition></S100FC:definition>
        <S100FC:code>60</S100FC:code>
    </S100FC:listedValue>
</S100FC:listedValues>
</S100FC:S100_FC_SimpleAttribute>
<S100FC:S100_FC_SimpleAttribute>
    <S100FC:name>Transmitting Station ID</S100FC:name>
    <S100FC:definition></S100FC:definition>
    <S100FC:code>transmittingStationID</S100FC:code>
    <S100FC:valueType>text</S100FC:valueType>
</S100FC:S100_FC_SimpleAttribute>
</S100FC:S100_FC_SimpleAttributes>
<S100FC:S100_FC_ComplexAttributes>
    <S100FC:S100_FC_ComplexAttribute>
        <S100FC:name>Feature name</S100FC:name>
        <S100FC:definition>The complex attribute provides the name of an
entity, defines the national language of the name, and provides the option to display the
name at various system display settings.</S100FC:definition>
        <S100FC:code>featureName</S100FC:code>
        <S100FC:subAttributeBinding sequential="false">
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infinite="false">1</S100Base:upper>
            </S100FC:multiplicity>
            <S100FC:attribute ref="displayName"/>
        </S100FC:subAttributeBinding>
        <S100FC:subAttributeBinding sequential="false">
            <S100FC:multiplicity>
                <S100Base:lower>0</S100Base:lower>
                <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
            </S100FC:multiplicity>
            <S100FC:attribute ref="language"/>
        </S100FC:subAttributeBinding>
        <S100FC:subAttributeBinding sequential="false">
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                <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
            </S100FC:multiplicity>

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        <S100FC:attribute ref="name"/>
        </S100FC:subAttributeBinding>
    </S100FC:S100_FC_ComplexAttribute>
    <S100FC:S100_FC_ComplexAttribute>
        <S100FC:name>Fixed date range</S100FC:name>
        <S100FC:definition>The complex attribute describes single fixed
period, as the date range between its sub-attributes.</S100FC:definition>
        <S100FC:code>fixedDateRange</S100FC:code>
        <S100FC:remarks>the sub-attributes date start and date end must
be encoded using 4 digits for the calendar year (YYYY) and, optionally, 2 digits for the
month (MM) (e.g. April = 04) and 2 digits for the day (DD). When no specific month
and/or day is required/known, the values are replaced with dashes (-
).</S100FC:remarks>
        <S100FC:subAttributeBinding sequential="false">
            <S100FC:multiplicity>
                <S100Base:lower>0</S100Base:lower>
                <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
            </S100FC:multiplicity>
            <S100FC:attribute ref="dateEnd"/>
        </S100FC:subAttributeBinding>
        <S100FC:subAttributeBinding sequential="false">
            <S100FC:multiplicity>
                <S100Base:lower>0</S100Base:lower>
                <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
            </S100FC:multiplicity>
            <S100FC:attribute ref="dateStart"/>
        </S100FC:subAttributeBinding>
    </S100FC:S100_FC_ComplexAttribute>
    <S100FC:S100_FC_ComplexAttribute>
        <S100FC:name>Periodic date range</S100FC:name>
        <S100FC:definition>The complex attribute describes the active
period for a seasonal feature (e.g. a buoy), as the dates between its sub-
attributes.</S100FC:definition>
        <S100FC:code>periodicDateRange</S100FC:code>
        <S100FC:remarks>the sub-attributes date start and date end
should be encoded using 4 digits for the calendar year (YYYY),2 digits for the month
(MM) (e.g. April = 04) and 2 digits for the day (DD). When no specific year is
required(i.e. the feature is removed at the same time each year) the following two cases
may be considered: - same day each year: ----MMDD - same month each year: ----MM--
This conforms to ISO 8601:2004.</S100FC:remarks>
        <S100FC:subAttributeBinding sequential="false">
            <S100FC:multiplicity>
                <S100Base:lower>1</S100Base:lower>

```

```

        <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
        </S100FC:multiplicity>
        <S100FC:attribute ref="dateEnd"/>
    </S100FC:subAttributeBinding>
    <S100FC:subAttributeBinding sequential="false">
        <S100FC:multiplicity>
            <S100Base:lower>1</S100Base:lower>
            <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
                </S100FC:multiplicity>
                <S100FC:attribute ref="dateStart"/>
            </S100FC:subAttributeBinding>
        </S100FC:S100_FC_ComplexAttribute>
    </S100FC:S100_FC_ComplexAttributes>
    <S100FC:S100_FC_InformationTypes>
        <S100FC:S100_FC_InformationType>
            <S100FC:name>DGNSS Station Region</S100FC:name>
            <S100FC:definition></S100FC:definition>
            <S100FC:code>DgnssStationRegion</S100FC:code>
            <S100FC:attributeBinding sequential="false">
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                    <S100Base:lower>1</S100Base:lower>
                    <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
                        </S100FC:multiplicity>
                        <S100FC:attribute ref="dateOfIssue"/>
                    </S100FC:attributeBinding>
                <S100FC:attributeBinding sequential="false">
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                        <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
                            </S100FC:multiplicity>
                            <S100FC:attribute ref="dateOfLastUpdate"/>
                        </S100FC:attributeBinding>
                    <S100FC:attributeBinding sequential="false">
                        <S100FC:multiplicity>
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                        </S100FC:multiplicity>
                        <S100FC:attribute ref="country"/>
                    </S100FC:attributeBinding>
                </S100FC:S100_FC_InformationType>
    </S100FC:S100_FC_InformationType>
        <S100FC:name>DGNSS Station Almanac</S100FC:name>

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```

<S100FC:definition></S100FC:definition>
<S100FC:code>DgnssStationAlmanac</S100FC:code>
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infinite="false">1</S100Base:upper>
  </S100FC:multiplicity>
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</S100FC:attributeBinding>
<S100FC:attributeBinding sequential="false">
  <S100FC:multiplicity>
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    <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
  </S100FC:multiplicity>
  <S100FC:attribute ref="signalFrequency"/>
</S100FC:attributeBinding>
<S100FC:attributeBinding sequential="false">
  <S100FC:multiplicity>
    <S100Base:lower>0</S100Base:lower>
    <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
  </S100FC:multiplicity>
  <S100FC:attribute ref="nominalRangeat"/>
</S100FC:attributeBinding>
<S100FC:attributeBinding sequential="false">
  <S100FC:multiplicity>
    <S100Base:lower>0</S100Base:lower>
    <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
  </S100FC:multiplicity>
  <S100FC:attribute ref="nominalRangeKm"/>
</S100FC:attributeBinding>
<S100FC:attributeBinding sequential="false">
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    <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
  </S100FC:multiplicity>
  <S100FC:permittedValues>
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    <S100FC:value>2</S100FC:value>
    <S100FC:value>3</S100FC:value>
    <S100FC:value>4</S100FC:value>
  </S100FC:permittedValues>

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```
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infinite="false">1</S100Base:upper>
        </S100FC:multiplicity>
        <S100FC:attribute ref="referenceStationIDs"/>
    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
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            <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
        </S100FC:multiplicity>
        <S100FC:attribute ref="stationName"/>
    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
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            <S100Base:upper xsi:nil="true" infinite="true"/>
        </S100FC:multiplicity>
        <S100FC:permittedValues>
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            <S100FC:value>2</S100FC:value>
            <S100FC:value>3</S100FC:value>
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            <S100FC:value>10</S100FC:value>
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            <S100FC:value>14</S100FC:value>
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            <S100FC:value>16</S100FC:value>
            <S100FC:value>17</S100FC:value>
            <S100FC:value>18</S100FC:value>
            <S100FC:value>19</S100FC:value>
            <S100FC:value>20</S100FC:value>
            <S100FC:value>21</S100FC:value>
            <S100FC:value>22</S100FC:value>
```

```

        <S100FC:value>23</S100FC:value>
        <S100FC:value>24</S100FC:value>
        <S100FC:value>27</S100FC:value>
        <S100FC:value>31</S100FC:value>
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        <S100FC:value>37</S100FC:value>
        <S100FC:value>59</S100FC:value>
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    </S100FC:permittedValues>
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infinite="false">1</S100Base:upper>
    </S100FC:multiplicity>
    <S100FC:attribute ref="transmittingStationID"/>
</S100FC:attributeBinding>
</S100FC:S100_FC_InformationType>
<S100FC:S100_FC_InformationType>
    <S100FC:name>Supplementary information</S100FC:name>
    <S100FC:definition>Information about a feature or a number of
features additional to that able to be encoded using other feature
attributes.</S100FC:definition>
    <S100FC:code>SupplementaryInformation</S100FC:code>
    <S100FC:attributeBinding sequential="false">
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    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
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infinite="false">1</S100Base:upper>
        </S100FC:multiplicity>
        <S100FC:attribute ref="pictorialRepresentation"/>
    </S100FC:attributeBinding>
</S100FC:attributeBinding sequential="false">

```

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        <S100FC:multiplicity>
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        </S100FC:multiplicity>
        <S100FC:attribute ref="textualDescription"/>
    </S100FC:attributeBinding>
</S100FC:S100_FC_InformationType>
</S100FC:S100_FC_InformationTypes>
<S100FC:S100_FC_FeatureTypes>
    <S100FC:S100_FC_FeatureType>
        <S100FC:name>Radio station</S100FC:name>
        <S100FC:definition>A place equipped to transmit radio
waves.</S100FC:definition>
        <S100FC:code>RadioStation</S100FC:code>
        <S100FC:remarks>Such a station may be either stationary or
mobile, and may also be provided with a radio receiver. In British terminology, also
called 'w/t station'. The transmission of a radio station may serve to provide mariners
with a line of position (IHO Chart Specifications, M-4). The object 'radio station' is used
to encode the point of transmission of the signal.</S100FC:remarks>
        <S100FC:alias>RDOSTA</S100FC:alias>
        <S100FC:attributeBinding sequential="false">
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                <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
            </S100FC:multiplicity>
            <S100FC:attribute ref="callSign"/>
        </S100FC:attributeBinding>
        <S100FC:attributeBinding sequential="false">
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infinite="false">1</S100Base:upper>
            </S100FC:multiplicity>
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                <S100FC:value>8</S100FC:value>
                <S100FC:value>9</S100FC:value>
                <S100FC:value>10</S100FC:value>
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                <S100FC:value>19</S100FC:value>
                <S100FC:value>20</S100FC:value>
            </S100FC:permittedValues>
    </S100FC:S100_FC_FeatureType>
</S100FC:S100_FC_FeatureTypes>

```

```

        <S100FC:attribute ref="categoryOfRadioStation"/>
    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
        <S100FC:multiplicity>
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        </S100FC:multiplicity>
        <S100FC:attribute ref="communicationChannel"/>
    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
        <S100FC:multiplicity>
            <S100Base:lower>0</S100Base:lower>
            <S100Base:upper xsi:nil="true" infinite="true"/>
        </S100FC:multiplicity>
        <S100FC:attribute ref="featureName"/>
    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
        <S100FC:multiplicity>
            <S100Base:lower>0</S100Base:lower>
            <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
        </S100FC:multiplicity>
        <S100FC:attribute ref="fixedDateRange"/>
    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
        <S100FC:multiplicity>
            <S100Base:lower>0</S100Base:lower>
            <S100Base:upper xsi:nil="true" infinite="true"/>
        </S100FC:multiplicity>
        <S100FC:attribute ref="periodicDateRange"/>
    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
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            <S100Base:upper xsi:nil="false"
infinite="false">1</S100Base:upper>
        </S100FC:multiplicity>
        <S100FC:attribute ref="scaleMinimum"/>
    </S100FC:attributeBinding>
    <S100FC:attributeBinding sequential="false">
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            <S100Base:upper xsi:nil="true" infinite="true"/>
        </S100FC:multiplicity>
        <S100FC:permittedValues>
            <S100FC:value>1</S100FC:value>

```

```
<S100FC:value>2</S100FC:value>
<S100FC:value>4</S100FC:value>
<S100FC:value>5</S100FC:value>
<S100FC:value>7</S100FC:value>
<S100FC:value>8</S100FC:value>
</S100FC:permittedValues>
<S100FC:attribute ref="status"/>
</S100FC:attributeBinding>
<S100FC:featureUseType>geographic</S100FC:featureUseType>
<S100FC:permittedPrimitives>point</S100FC:permittedPrimitives>
</S100FC:S100_FC_FeatureType>
</S100FC:S100_FC_FeatureTypes>
</S100FC:S100_FC_FeatureCatalogue>
```