

IHO Tidal Height Product Specification

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***** Note I have used entity through the document to indicate “point” specific data. According to S100 feature catalogue can use GM_Point or pointsets (a set of GM_Point). The main difference is a wether we want each tidal height locations to have its own file or have all the tidal height locations as a single file (single point feature or irregular points features).*

Pointsets are considered a type of coverage.

This document assumes gone with GM_Point

*[S100 Table A.21 and Section 8]*****

1. Background

The development of electronic navigation with high resolution bathymetric data, and the drive to increase mariners’ safety are now demanding temporal data such as tidal heights to be available.

The Tidal Height Single Point Product describes the provision of tidal height data as single entity *irrespective of whether they are observations, model derived predictions.*

2. Introduction

This document describes an S-100 compliant product specification for Tidal Height Single Point Product.

The Tidal Height Single Point Product may be used alone or it may be combined with ENC or other S-100 compatible data. As such this Tidal Height Single Point Product specification describes one of a number of additional information that could be integrated with other S-100 products for use with ENC.

The Tidal Height Single Point Product specification defines a content model and *an exchange file format for the exchange of tidal height entity data.* There currently are no recognized standards on the exchange of tidal height single point data.

3. Scope

This document is a product specification for tidal height data which may be used alone r as an auxiliary layer of data with an ENC. It specifies *an entity* including

IHO Tidal Height Product Specification

both height and uncertainty. This product specification includes a content model and separate encodings.

4. Conformance

This product schema is conformant with IHO S-100 Sections ?

5. Normative references

- 5.1. IHO S.100 IHO Universal Hydrographic Data Model, January 2010
- 5.2. IHO S.44 Standards for Hydrographic Surveys 5th Edition, February 2008
- 5.3. ISO 8601:2004 Data elements and interchange formats _ Information interchange _ Representation of dates and times ISO/TS 19103:2005 Geographic information – Conceptual schema language
- 5.4. ISO 19111:2003 Geographic information – Spatial referencing by coordinates
- 5.5. ISO 19115:2003 Geographic information – Metadata
- 5.6. ISO 19115-2:2009 Geographic information – Metadata: Extensions for imagery and gridded data
- 5.7. ISO 19123:2005 Geographic information – Schema for coverage geometry and functions
- 5.8. ISO 19129:2009 Geographic information – Imagery gridded and coverage data framework
- 5.9. ISO 19131:2007 Geographic information – Data product specifications
- 5.10. ISO/IEC 19501:2005, Information technology — Open Distributed Processing – Unified Modelling Language Version 1.4.2

Note: a summary of UML is given in S.100 Part 1.

6. Use of Language (Optional)

Within this document:

- *“Must” indicates a mandatory requirement.*
- *“Should” indicates an optional requirement, that is the recommended process to be followed, but is not mandatory.*

IHO Tidal Height Product Specification

- *“May” means “allowed to” or “could possibly”, and is not mandatory.*

7. Terms and Definitions

Terms and definitions have been taken from the normative references cited in clause 3. Only those which are specific to this document have been included and modified where necessary. Additional terms are defined in this document.

7.1. coordinate

one of a sequence of numbers designating the position of a point in N-dimensional space [ISO 19111]

7.2. coordinate reference system

coordinate system which is related to the real world by a datum [ISO 19111]

7.3. direct position

position described by a single set of coordinates within a coordinate reference system [ISO 19107]

7.4. domain

well-defined set [ISO 19103]

NOTE Domains are used to define the domain set and range set of operators and functions.

7.5. elevation

the altitude of the ground level of an object, measured from a specified vertical datum. [IHO S100 GFM]

7.6. feature

abstraction of real world phenomena [ISO 19101]

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

7.7. height

distance of a point from a chosen reference surface measured upward along a line perpendicular to that surface. [ISO 19111:2006]

NOTE Height is distinguished from elevation in that is a directional measurement.

7.8. Record

IHO Tidal Height Product Specification

Finite, named collection of related items (objects or values) [ISO 19107]

NOTE Logically, a record is a set of pairs <name,item>

7.9. uncertainty

The interval (about a given value) that will contain the true value of the measurement at a specific confidence level [IHO S44]

NOTE Errors exist and are the differences between the measured value and the true value. Since the true value is never known it follows that the error itself cannot be known. Uncertainty is a statistical assessment of the likely magnitude of this error.

8. Symbols and abbreviations terms

8.1. Abbreviations

CRS	Coordinate Reference System
ECDIS	Electronic Chart Display Information System
EPSG	European Petroleum Survey Group
ENC	Electronic Navigational Chart
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization

8.2. Notation

In this document conceptual schemas are presented in the Unified Modelling Language (UML). Several model elements used in this schema are defined in ISO standards developed by ISO TC 211, or in IHO S-100. In order to ensure that class names in the model are unique ISO TC/211 has adopted a convention of establishing a prefix to the names of classes that define the TC/211 defined UML package in which the UML class is defined. Since the IHO standards and this product specification make use of classes derived directly from the ISO standards this convention is also followed here. In the IHO standards the class names are identified by the name of the standard, such as "S100" as the prefix optionally followed by the bialpha prefix derived from ISO. For the classes defined in this product specification the prefix is "*S10n*". In order to avoid having multiple classes instantiating the same root classes, the ISO classes and S-100 classes have been used where possible; however, a new instantiated class is required if there is a need to alter a class

IHO Tidal Height Product Specification

or relationship to prevent a reverse coupling between the model elements introduced in this document and those defined in S-100 or the ISO model.

Table 1 – Sources of externally defined UML classes

Prefix	Standard	Package
CI	ISO 19115	Citation and Responsible Party
CV	ISO 19123	Coverage Core & Discrete Coverages
DQ	ISO 19115	Data Quality Information
DS	ISO 19115	Metadata Application Information
EX	ISO 19115	Metadata Extent information
IF	ISO 19129	Imagery Gridded and Coverage Data Framework
LI	ISO 19115	Lineage Information
MD	ISO 19115	Metadata entity set information
MI	ISO 19115-2	Metadata entity set imagery
S100	IHO S-100	IHO Standard for Hydrographic Data
SC	ISO 19111	Spatial Referencing by Coordinates
SD	ISO 19130	Sensor Data
S101	IHO S-101	IHO Electronic Navigational Chart Product Specification
S102	IHO S-102	IHO Bathymetric Surface Product Specification

9. Overview

9.1. Title

[S-10n – Tidal Height Single Point Product Specification](#)

9.2. Reference Date

Proposed draft MMM YYYY (date to be revised when finalized)

9.3. Responsible Party

International Hydrographic Bureau.

4 quai Antoine 1er

B.P. 445 MC 98011 MONACO CEDEX

Telephone: +377 93 10 81 00

Telefax: + 377 93 10 81 40

9.4. Language

Data products conforming to this product specification are available in English and additionally in other national languages together with English. That is, English or

IHO Tidal Height Product Specification

English plus another language or languages shall be used in the metadata associated with the set of values defining the tidal height *entity*.

9.5. Informal description of the data product

10. Specifications Scopes

10.1. Scope general

10.2. Scope identification

10.3. Level

10.4. Level name

10.5. Spatial extent:

Description: Areas where Tidal Information is available

East Bounding Longitude: 180°

West Bounding Longitude: 180°

North Bounding Longitude: 90°

South Bounding Longitude: -90°

10.6. Temporal Extent

11. Data product identification

11.1. Title: Tidal Height Single Point Product

11.2. *Alternate Title(optional –e.g. existing industry standard, acronym etc)*
Example: THSPP- short for tidal height single point product

11.3. Abstract: S-10n THSPP must be produced in accordance with the rules defined in S-10n Product Specification. The S-10n Product specification contains all the information necessary to enable Hydrographic Offices to produce a consistent THSPP, and manufacturers to use that data efficiently in an ECDIS or other Navigational planning tools to satisfy IMO Performance Standards for ECDIS.

11.4. Purpose: For use with Electronic Chart Display and Navigational Systems

IHO Tidal Height Product Specification

11.5. Topic category: *Need to determine which best describes [ISO 19115 B.5.27], options are:*

Name	Domain Code	Definition
Elevation	006	Height above or below mean sea level Examples: altitude, bathymetry, digital elevation models, slope, derived products
Inland Waters	012	Inland water features, drainage systems and their characteristics Examples: rivers and glaciers, salt lakes, water utilization plans, dams, currents, floods, water quality, Hydrographic charts
Oceans	014	Features and characteristics of salt water bodies(excluding inland waters) Examples: tides, tidal waves, coastal information, reefs

Given that the group covers inland waters as well as coastal, it maybe that all options are required and leave it to the producing authorities to choose the most appropriate.

11.6. Spatial representation type:

Type of spatial representation for the product, as defined by the ISO 19115 MD_SpatialRepresentationTypeCode [B.5.26]:

Vector, Domain Code 001

11.7. Spatial resolution: *Do we want to define a scale range within which the dataset should be used?*

Table 2 S-101 ENC Minimum Display and Maximum Display Scales

Scale
1:10,000,000
1:3,500,000
1:1,500,000
1:700,000
1:350,000
1:180,000
1:90,000
1:45,000
1:22,000

IHO Tidal Height Product Specification

1:12,000
1:8,000
1:4,000
1:3,000
1:2,000
1:1,000

11.8. Reference to product specification scope

Global

Note: "Global" means that this scope refers to all parts of this data product specification.

12. Data content and structure

12.1. Description

The tidal height product is a single point entity that contains a time series of tidal heights and associated uncertainty relative to a vertical reference datum. It is made up of the following components

[Metadata](#)

[Time series](#)

[Uncertainty](#)

12.2. *Entity* Information

12.2.1. Template Application Schema

12.2.2. Application Schema Implementation Classes

12.2.3. Implementation Classes Description

12.2.3.1. *S10n_TidalHeightEntity*

12.2.3.2. *S10n_UncertaintyValues*

12.2.3.3. DirectPosition

12.2.3.3.1. DirectPosition semantics

The class DirectPosition holds the coordinates for a position within some coordinate reference system.

IHO Tidal Height Product Specification

12.2.3.3.2. coordinate

The attribute *coordinate* is a sequence of Numbers that hold the coordinate of this position in the specified reference system.

12.2.3.3.3. dimension

The attribute *dimension* is a derived attribute that describes the length of the coordinate.

12.2.3.4. Vector

12.2.3.4.1. Vector semantics

The class Vector is an ordered set of numbers called coordinates that represent a position in a coordinate system.

12.2.3.4.2. dimension

The attribute *dimension* is a derived attribute that describes the length of the sequence of vector coordinates.

12.2.3.4.3. coordinates

The attribute *coordinates* is a sequence of Numbers that hold the coordinate of this position in the specified reference system.

12.2.3.5. Etc

12.2.4. Digital Signature Block Implementation Class – S-102 have implemented this as part of the S-10n_CollectionMetadata – do we want to do something similar? Is this applicable?

12.2.5. Metadata

The Metadata elements used in the Bathymetric Surface product are derived from S-100 and from ISO 19115 and ISO 19115-2. Optionally additional metadata may be derived from ISO 19130 and ISO 19130-22 especially metadata relating to the SONAR equipment which may have been used to acquire the bathymetric data. There are only a few elements in the ISO 19115 metadata standard that are mandatory and these relate only to the use of the metadata for identification and pedigree of the data set. A minimum level of data identification is required for all applications including database applications, web services and data set production. *However, S10n requires certain metadata attributes which are used to geolocate the dataset as well as lineage attribution which define processes used to establish the tracking list and establish a pedigree for the data.* The elements are related in a metadata schema, and include definitions and extension procedures.

IHO Tidal Height Product Specification

There exist both mandatory and conditional metadata elements. Only a few metadata elements are mandatory but the inclusion of some of the optional metadata elements establish a situation where other metadata elements are conditionally made mandatory. The following table outlines the core metadata elements (mandatory and recommended optional) required for describing a geographic information data set. The codes indicate: "M" mandatory, "O" optional, "C" conditional as defined in ISO 19115. The table indicates how the mandatory and conditional core metadata are handled in [S-10n](#).

Table 3 - ISO TC211 Core Metadata as applied in S-10n

Insert table of metadata

12.2.6. Discovery Metadata

12.2.7.

12.2.8. Structure Metadata

12.2.9. Quality Metadata

12.2.10. Acquisition Metadata *Optional*

12.2.11. Feature Catalogue

12.2.12. Reference to product specification scope

12.3. Extensions

The Tidal Height Product Specification is extensible. This includes both extensions to the content model and to the encodings supporting the content model. Extensions are optional and not required for a file to be qualified nor do they invalidate a compliant product. Additional layers of information not related to the scope of this product specification should be defined in separate S.100 and S.10x compliant layers.

12.4. Coordinate Reference Systems *Below only covers "coverage", a single "entity" still needs to be covered*

12.4.1. Spatial Representation

All coverages in the Bathymetric Surface Product Specification are georectified, simple uniform quadrilateral grids as defined in IHO S-100 Part 8.

All [S-10n](#) Tidal Height product coverages shall be represented with a right-handed Cartesian coordinate system. This system shall have the x-axis oriented towards positive eastings (for projected grids), or east (for geographic grids), and y-axis oriented towards positive northings (for projected grids), or north (for geographic grids). These definitions imply that the z-axis for the sounding data is positive away from the center of mass of the earth (i.e., is positive up), rather than the usual hydrographic convention of positive down (i.e., deeper depths are larger numbers and

IHO Tidal Height Product Specification

negative depths are above datum). User-level code is free to make this reflection if required, but must write the data using the positive-up convention.

In order to make this distinction clear, the term —elevation || is used for the vertical component, rather than —depth || . The uncertainty component shall have the same coordinate system as the elevation component, with the exception that the z-axis is unipolar, and therefore the concept of direction of positive increase is irrelevant. The grid data in a S-10N Tidal Height coverage (either elevation or uncertainty, and any other surfaces that may be added) shall be organized as a uniform quadrilateral grid in row-major order from west to east, and south to north. Thus, the first sample of the grid is the node at the southwest corner of the grid with location as specified by the georeferencing parameters, the second is one grid resolution unit to the east of that position and at the same northing or latitude, and the third is two grid resolution units to the east and at the same northing or latitude. For C columns in the grid, the (C+1)th sample in the grid is located one grid resolution unit to the north, but on the same easting, or longitude, as the first sample in the grid.

12.4.2. Coordinate Reference system

12.4.3. Data quality

As defined in IHO S-100 Part 4c the data quality for the elevation coverage is also defined as a co-located coverage, uncertainty. Uncertainty is defined as the vertical uncertainty at each node location. The uncertainty coverage supports multiple definitions of vertical uncertainty.

13. Data Capture

13.1. Description

There area number of methods to observe, analyse and predict tidal heights. It is permitted, but not required to include methodology in the metadata of an *S-10n Tidal Height Single Point product*. *The metadata class S10n_MethodologyMetadata has been defined, but the information elements to populate this metadata class should be identified in a National profile of S10n.*

13.2. Reference to product specification scope

Global.

Note: “Global” means that this scope refers to all parts of this data product specification.

14. Data Maintenance

14.1. Description

14.2. Reference to product specification scope

Global.

IHO Tidal Height Product Specification

Note: "Global" means that this scope refers to all parts of this data product specification.

15. Encoding

15.1. Encoding Principles

The ISO suite of geographic information standards is built on the concept of the separation of the "carrier" from the "content". This is reiterated in S-100 where several encoding approaches are identified. The content is defined in the product specification for any type of data, such as the S-10N Bathymetry Surface Product Specification, in terms of an encoding neutral UML model. Elements from this model are then used to create an Application Schema that is then encoded. Different layers of other auxiliary data may have different encodings. The encoding is described in Annex A is the current implementation. The possibility of using JPEG 2000 + XML is considered as a future longer term option, but is not yet viable until software tools become commonplace. It is possible, but probably not practical to develop a coding using ISO 8211 data descriptive file for information interchange standard. Not only are there no tools available to handle coverage data, but the standard is not widely used for this type of information, so there are not likely to be any such tools available.

IHO Tidal Height Product Specification

ANNEX A: Metadata
Data will be supplied in UTC.

Name/Role	Source	Multiplicity	Value	Type	Remarks
Unique Identifier		1		Character/numerical	
Unique Name		1		Character string	
Vertical Datum	S101	1	{1} to {30}	S100_VerticalAndSoundingDatum	<ol style="list-style-type: none"> 1. Mean low water springs 2. Mean lower low water 3. Mean sea level 4. Lowest low water 5. Mean low water 6. Lowest low water 7. Approximate mean low water springs 8. Indian spring low water 9. Low water springs 10. Approximate lowest astronomical tide 11. Nearly lowest low water 12. Mean lower low water 13. Low water 14. Approximate mean low water 15. Approximate mean lower low water 16. Mean high water 17. Mean high water springs 18. High water 19. Approximate mean sea level 20. High water springs 21. Mean higher high water 22. Equinoctial spring low water

Comment [AHO1]: Where I grab information to populate table

IHO Tidal Height Product Specification

					<ul style="list-style-type: none"> 23. Lowest astronomical tide 24. local datum 25. International Great Lakes Datum 1985 26. Mean water level 27. Lower low water large tide 28. Higher high water large tide 29. Nearly highest high water 30. Highest astronomical tide 31. HYDROID (New - to cover ellipsoidal connection?)
Issuing Authority	S101			CI_ResponsibleParty	Use S62 – IHO Producers list Agency responsible for producing the data.
Type of height data			1- 4		<ul style="list-style-type: none"> 1. Observed 2. Astronomical Predictions 3. Numerical Model 4. Full Forecast Model 5. <i>**Check list with S111 to use same list*</i>
Issue Date and time	S101	1		Date and time Yyyy/mm/dd hh:mm	Date on which the data was made available by the data producer. Mandatory for predicted height data.

Comment [AH02]: Do we want to suggest a new datum be added?

Possible consider the following metadata especially for predictions that may be reissued

Name/Role	Source	Multiplicity	Value	Type	Remarks
Purpose	S101	1	{1} to {5}	characterString MD_Identification>purpose(character string)	<ul style="list-style-type: none"> 1. New dataset 2. New Edition 3. Update 4. Re-issue 5. Cancellation

Comment [AH03]: Where I grab information to populate table

Comment [AH04]: May require this one for predictions that are reissued.

IHO Tidal Height Product Specification

Copyright	S101	0..*		MD_LegalConstraints - >MD_RestrictionCode<copyright> (ISO19115)	
Classification	S101	1	{1} to {5}	Class MD_SecurityConstraints>MD_ClassificationCode(codelist)	1. unclassified 2. restricted 3. confidential 4. secret 5. top secret
Uncertainty of Time				<i>Seconds or fraction of a second or flag value</i>	

Annex B DataEntity

Name/Role	Source	Multiplicity	Value	Type	Remarks
Position (x,y)					Latitude and Longitude of the entity
Coordinate Reference System datum	S100	1		SC_CoordinateSystem	Coordinate system used for position.
Height Units					Must be in metres.
Interval Step / sampling interval					
Date & time					
Water level Height					Observed/ predicted
Uncertainty of Height					
Water level trend methodology				Character string (maximum length?)	

Comment [AH05]: Where I grab information to populate table

Note S-57 had
Feature: T_TIMS – Tide Time Series
Attributes

IHO Tidal Height Product Specification

Alphacode	Name	Data type	Definition	Remarks
NOBJNM	Object name in national language	Text	Name of object in national language characters.	The attribute "object name in national language encodes the individual name of an object in the specified national language.
OBJNAM	Object name	Text	The individual name of an object	
STATUS	Status	Enumerations		<ol style="list-style-type: none"> 1. permanent 2. occasional 3. recommended 4. not in use 5. periodic/intermittent 6. reserved 7. temporary 8. private 9. mandatory 10. 11. extinguished 12. illuminated 13. historic 14. public 15. synchronized 16. watched 17. un-watched 18. existence doubtful 19. on request 20. drop away 21. rising 22. increasing 23. decreasing

IHO Tidal Height Product Specification

				24. strong 25. good 26. moderately 27. poor
TIMEND	Time end	Structure text	The end of an active period	
TIMSTA	Time start	Structured text	The start of an active period	
T_ACWL	Tide – accuracy of water level	Enumeration	Accuracy of the water level to the confidence level of 95%	1 – better than 0.1m and 10 minutes 2 – worse than 0.1m or 10 minutes
T_HWLW	Tide – high and low water values	Structured text	Information on the times and heights of high and low waters for each day of the duration of the time series	
T_TINT	Tide, current – tide interval of values	Integer	The interval between the values in any time series, e.g. tidal, current or other data.	
T_TSVL	Tide – time series values	Structured text	The values of a time series	