International Hydrographic Organisation (IHO)

Tidal and Water Level Working Group (TWLWG)

TWLWG-Task_C.1

Tidal Heights – Proposed S-57 Objects and Attribute Catalogue

Document History

Version	Who	Description of Change*	Date
1.0	AUS	New Document	22/10/2010

* Note: This document is the outcome of ongoing review amongst WG members. The Change Description only provides a brief comment on changes.

Contents

1. Background

The IHO Tidal and Water Level Working Group (TWLWG) has been tasked with liaising with the IHO TSMADWG regarding the development of dynamic tides in ECDIS. The concept of dynamic tides is not new and is the subject of numerous technical papers (see References).

Object and attributes related to tidal heights (and streams) already exist in S-57 (now S-100) and were defined in the early 1990's through cooperative work between the then IHO DBWG and the IHO Tidal Committee (TC). The current membership of the TWLWG have not had much exposure to S-57/S-100. At the TWLWG2 meeting in Stavangar (April 2010), the WG were led through an introductory training session on the development and the data modelling concepts of S-57. This led to a session whereby:

- Tidal height data that can possibly be supplied by the HO's was modelled in terms of current and potential objects and attributes;
- A comparison was made with the existing S-57objects and attributes to identify what changes may be required within S-57 object and attribute registries to encode the tidal height data.

This document defines/clarifies new and existing S-57 objects and attributes – what exists, what changes are required and what other formats may be required to supply data (e.g. gridded data) as S-57 transitions to S-100.

This document only addresses tidal height data. The handling of tidal streams will need to be dealt with at a later stage.

Tidal Modelling

The WG also identified a further object related to a "Tidal Model" comprising gridded points. This model is not considered to be suitable for S-57 but will fit within a S-100 realm and the Gridded product specification S-102 could be a likely fit. Some gridded data was supplied by France and its usefulness in terms of a suitable structure requires wider consideration by the WG. For this reason, this object has not been yet defined in this document.

2. Impact on other IHO S-57 Related Specifications

In making any changes to existing S-57 objects or attributes, the WG must consider the effects on other related documents, standards and stakeholders. These include:

- **Existing data encoding:** Some HO's may have already encoded data using the existing tidal height objects and attributes. Any changes will impact existing published ENC data;
- **S-57 ENC Product Specification:** Any definition of objects and attributes need to consider the impact on the existing S-57 data structures of an ENC e.g. spatial definition of a data cell, the use of meta-data fields to reduce redundant attribute encoding and the definition of mandatory attributes. The ENC PS document is being re-written as S-101 and is expected to be published by the IHO in 2012.
- **Use of the Object Catalogue:** This document needs to be reviewed in terms of updating any encoding guidance to assist data producers with generating consistent data.
- **S-58 Recommended ENC Validation Checks:** Any changes to the ENC Product Specification will require a review of any ENC Validation checks that may be affected or may require new checks.
- **S-52 Presentation Library:** How is this data to be presented to the end-user? This will require liaison with the IHO Data Portrayal WG.

3. Development and Review Process

The recommended process for developing and reviewing the tidal height S-57 objects and attributes is described in a series of stages as follows:

Stage 1: Initial Development and Refinement of the Objects and Attributes

A revised object and attribute catalogue will be prepared by Australia with input from other sub WG members based on the current S-57 Object and Attribute Catalogue structure.

- For each object and attribute, the layout is as follows:
  - A summary of the proposed changes is included;
  - The object and attribute page is defined;
  - A detailed example of the encoding is provided. Examples will indicate where mandatory attributes will be required;
  - Any additional comments.
- Objects and/or attributes that require no changes from their existing format are listed but not shown in any detail (e.g. OBJNAM, INFORM, etc.);
- An **object** that requires **additional existing** S-57 attributes will have those attributes shown in **GREEN**;
- An **attribute** that **currently exists, but requires some modification** in terms of interpretation, applicability, use, etc are listed in **RED**;
- **New objects or attributes** are shown in **BLUE**;
- Not all attributes that are listed for an object need to be populated;
- Some object attributes will be **mandatory** depending upon usage and coding requirement. The mandatory encoding is defined in the ENC Product Specification and further encoding guidance and interpretation is provided in the Use of the Object Catalogue.

Completed: 22 October 2010

Stage 2: Object Catalogue is distributed to TWLWG Task Group (TG) members for Comment and consequent Modifications

The document will be in a similar format to the S-57 object and attribute catalogues. It will be distributed to the nominated TG members identified in the TWLWG Meeting 2 Minutes (Australia (lead), Chile, France, South Africa, UK) (TWLWG2/8 4.3.6)

TG members may seek comment from their TSMADWG colleagues and other interested parties. Comments and recommended modifications will be incorporated under a version control process.

It is recommended that Comments and Modifications will be managed through the “track changes” in the actual WORD document.

Stage 3: Object Catalogue and proposed Maintenance Document is distributed to all TWLWG members for comment and consequent modifications

Once all comments and modifications have been incorporated, the document will be forwarded to all TWLWG members and interested parties for further review and comment.

WG members may seek comment from their TSMADWG colleagues. Comments and recommended modifications will be incorporated under a version control process. It is recommended that Comments and Modifications will be managed through a maintenance document rather than embedded in the actual WORD document.

Stage 4: Endorsement of the Tidal Heights Object and Attribute Catalogue

Depending upon timing, either through correspondence or at the next TWLWG Meeting Number 3, the WG will endorse the object and attribute catalogue document for submission to the TSMADWG.

Stage 5: Submission of Objects/Attribute Proposal to TSMADWG for Consideration

The mandate of the TWLWG is to define a capability for S-57. At this stage, S-57 is frozen so no new objects and attributes can be incorporated into S57. This may change in the future, however, irrespective of S57, tidal height objects and attributes will need to be defined in S-100 syntax. S-100 describes the registration process for amending object and attribute registries. The submission process will likely require some input from TSMADWG members to assist with re-formatting the S-57 documents into S-100.

4. List of Existing Objects and Attributes

S-57 currently comprises the following tidal height and related objects:

S-57 Objects	Interpretation for Use
SISTAW – Signal Station, warning	CATSIW = 12 (tide gauge measuring device) CATSIW = 13 (tide scale) CATSIW = 15 (tide gauge measuring device in non-tidal waters) CATSIW = 10 – should be reviewed for interpretation and requirement
T_HMON – Tide, Harmonic Prediction	T_ACWL, T_MTOD, T_VAHC
T_NHMN – Tide, non-harmonic prediction	T_ACWL, T_MTOD, T_THDF
T_TIMS – Tide, Time Series	T_ACWL, T_HWLW, T_TINT, T_TSVL, TIMEND, TIMSTA
CTRPNT – Control Point	CATCTR = 4 (Benchmark) CATCTR = 1 (Triangulation Point) VERDAT
S-57 Attributes	**Interpretation for Use**
CATSIW – Category of Signal Station, Warning	CATSIW = 12 (tide gauge measuring device) CATSIW = 13 (tide scale) CATSIW = 15 (tide gauge measuring device in non-tidal waters) CATSIW = 10 – should be reviewed for interpretation and requirement
T_ACWL	Accuracy of water level in terms of both height units and time to a 95% C.L.
T_MTOD	Method of tidal prediction covering both harmonic and non-harmonic
T_VAHC	Harmonic constituent list as an array
T_THDF	Time and height differences comparative to a reference station
T_HWLW	Date/Time and height pairs of high and low waters
T_TINT	Time interval between data values
T_TSVL	Tidal height above/below datum in a time series
TIMEND	Time format for the end of an active period
TIMSTA	Time format for the start of an active period
COMCHA	Communication channel - VHF only
ESTRNG	Estimated range (distance) of transmission
CATCTR	CATCTR = 4 (Benchmark) CATCTR = 1 (Triangulation Point)

VERDAT	Currently a list of 30 different vertical reference datum.

5. Quality Objects and Attributes

The following table identifies the existing S-57 quality-related objects and attributes and discusses their potential use for providing tidal height quality metadata.

Objects	Comments regarding use with Tidal Height Data
M_QUAL	This object only relates to sounding data and Zone of Confidence (ZOC) encoding. Unless the M_QUAL: object is redefined, it is not an appropriate object for use with tidal data.
Attributes	
CATQUA	This attribute was developed to support Source Diagrams on paper charts. It is not suitable for tidal data.
CATZOC	This attribute was developed as a means of providing the mariner with an overall depiction of area quality based on the technology and the coverage of the underlying source hydrographic survey. It is not suitable for tidal data.
HORACC	Related to horizontal clearances and distances. It is not suitable for tidal data.
POSACC	Positional accuracy to the 95% CI (2.45 sigma) with respect to the given datum. Probably not required for height data, but could be used for tidal stream positional accuracy.
QUAPOS	This spatial attribute enables hydrographic charted features to be encoded with various quality tags to assist with symbolisation (e.g. pecked lines on coast, Rep, PA, PD, etc). It is not suitable for tidal data.
SOUACC	Only relevant to sounding depth accuracy. **NOTE: It is important that the total depth accuracy (sounding + tidal height) should somehow be reported to the user. This is an issue to be discussed with TSMADWG.**
VERACC	One dimensional error in height and for S57 is not to be used for sounding measurements. **This attribute can be used for the error in tidal heights however the current S-57 resolution being to 0.1 units will need to be amended to 0.001 units (i.e. 0.001 m or ft)**

Discussion

There appears to be little in the way of standardisation of data quality within the marine oceanographic community.

- ISO has defined Quality Standards (ISO 19113, 19114, 19115 and 19138) which are in the process of being updated.
- The MarineXML consortium through the IODE describes quality with 4 attribute values as “good, suspect, bad, unknown”.

- The ESEAS Data quality Manual under the GLOSS programme describes quality with 7 attribute values – “no quality control, good, probably good, probably bad, bad, interpolated, missing”
- IHO S-100 Part 4c describes Metadata Data Quality encoding

It is recommended that a small sub-WG be established to determine the requirements for reporting data quality indicators that is meaningful to the data being represented i.e. height accuracy, time accuracy, location – at a point or across an area, etc.

The IHO has re-established the Data Quality Working Group (DQWG) but it is not known how active they are or what assistance they may provide.

6. Object and Attribute Definition - Conventions

The following pages provide the recommended Objects and Attributes for Tidal Heights to be incorporated into S-57/S-100.

The pages follow the S-57 object and attribute catalogue structure for simplicity, but includes some additional features. The page structure is as follows:

- For each object and attribute, the page content is:
  - A summary of any proposed changes;
  - The object and attribute detail is defined as per S-57 constructs;
  - A detailed example of the encoding is given. Examples indicate where mandatory attributes are required;
  - Any additional comments.

To assist with interpreting the object and attributes, colour coding has been used:

- Objects and/or attributes that require no changes from their existing format are listed but not shown in any detail (e.g. OBJNAM, INFORM, etc.);
- An **existing object** that requires **additional existing** S-57 attributes will have those attributes shown in **GREEN**;
- An **existing attribute** that **requires some modification** in terms of definition, interpretation, applicability, are listed in **RED**;
- **New objects or attributes** are shown in **BLUE**

For general S-57 encoding purposes;

- Not all attributes that are listed for an object need to be populated;
- Some object attributes will be mandatory depending upon usage and encoding requirement. The mandatory encoding is defined in the ENC Product Specification and further encoding guidance and interpretation is provided in the Use of the Object Catalogue.

Additional notes impacting the ENC Product Specification and the Use of the Object Catalogue will need to be prepared to assist with the interpretation and impact on data encoding. These notes should be prepared closer to the time when the recommendations are passed to the TSMADWG for consideration.

7. References

The following documents were used to assist with preparing this document:

GLOSS, 2009. Quality Control of Sea Level Observations, May 2009, Version 0.1, adapted from the ESEAS Data Quality Manual.

Pineau-Guillou, private correspondence regarding France gridded data, July 2010.

Tronvig, K.A, Gill, S.K., undated, Complexities of Tidal Zoning for Key West, FL. This paper was probably presented at a US Hydrographic Symposium. I am sure that Stephen can advise.

www.metoc.gov.au/products/xml_schema/marine_xml_schema.html – Marine XML Schema Documentation.

TIDAL HEIGHT - GEO OBJECT CLASSES

SIGNAL STATION (SISTAW)

Recommended Change Summary

This is an **existing** S57 point object and requires changes to attributes as follows:

- **ESTRNG** – existing S57 attribute to define the estimated range of a data transmission from a transmitting tide gauge
- **VERACC** – existing S57 attribute to define the vertical accuracy of tidal height level values including CD2TGZ
- **CD2TGZ** – new attribute to define the height difference where known from Chart Datum to Tide Gauge Zero
- **STANUM** – new attribute to define the issuing authority's unique station identifier
- **CATTDS** – new attribute to define the type of tide station or port i.e. standard, secondary, transmitting, etc

An additional attribute may be required if tidal heights are transmitted in another encapsulation as COMCHA only outputs VHF data.

Object Definition

Acronym: **SISTAW**

Set Attribute_A: CATSIW; COMCHA; DATEND; DATSTA; NOBJNM; OBJNAM; PEREND; PERSTA; STATUS; **CD2TGZ**; **STANUM**; **CATTDS**; **ESTRNG, VERACC**

Set Attribute_B: INFORM; NINFOM; NTXTDS; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Definition:

A signal station is a place on shore from which signals are made to ships at sea. (IHO Dictionary, S-32, 5th Edition, 4742)

References:

INT 1: IT 20, 26, 28-36;

M-4: 490.3; 494.1-2; 496.1-3; 497;

Remarks:

This object class is used to describe the function of the signal station rather than the structure on which the station is sited.

Distinction: signal station, traffic;

Examples of Data Encoding

1. Tide Height Station (tidal) – non-transmitting

CATSIW (mandatory) = 12
OBJNAM = TWIN ISLAND
STANUM (mandatory) = 58100
CATTDS (mandatory) = 1
CD2TGZ = 0.05
VERACC = 0.002

2. Tide Height Station (tidal) – transmitting

CATSIW (mandatory) = 12
OBJNAM = INCE POINT
STANUM (mandatory) = 58140
CATTDS (mandatory) = 1,5
CD2TGZ = 0.0
COMCHA (mandatory when CATTDS includes a “5”) = 68
VERACC = 0.001
INFORM = Refer to the Australian Seafarers Handbook for a description of the location and transmission details for Tide Gauges and Current Meters in Torres Strait.

Additional Comments

None

CONTROL POINT (CTRPNT)

Recommended Change Summary

This is an **existing** S57 point object and requires changes to attributes as follows:

- **VERACC** – existing S57 attribute to define the vertical accuracy of tidal height level values including CD2TGZ

Object Definition

Acronym: **CTRPNT**

Set Attribute_A: CATCTR; DATEND; DATSTA; ELEVAT; NOBJNM; OBJNAM; **VERACC;** VERDAT;

Set Attribute_B: INFORM; NINFOM; NTXTDS; PICREP; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Definition:

A point on the ground where (horizontal and vertical) is used as a base for a dependent survey. Also referred at as a control station. (IHO Dictionary, S-32, 5th Edition, 1026)

References:

INT 1: IB 20-24;

M-4: 304.1-3; 305.1; 306

Remarks:

- AUS – VERDAT: Look at including an additional vertical reference datum for ellipsoidal heights.

Examples of Data Encoding

1. Tide Height Station (tidal) – non-transmitting

CATCTR (mandatory) = 4
OBJNAM = Sydney PM 101
ELEVAT = 6.647
VERACC = 0.001
VERDAT = 10 (approximate lowest astronomical tide)

TIDE – CO-TIDAL ZONE (T_COTZ)

Recommended Change Summary

This is a **new** AREA object defining similar tidal characteristics that have been derived from co-tidal lines of time difference and range. The object uses existing S-57 attributes as well as the following proposed new attributes:

- **T_RGFC** – new attribute to define the range factor to calculate the tidal heights
- **T_TADJ** – new attribute to define the time difference to be applied to heights based on the reference station
- **STANUM** – new attribute to define the issuing authority's unique station identifier that is used as the reference station for the T_COTZ polygon

Object Definition

Acronym: **T_COTZ**

Set Attribute_A: DATEND; DATSTA; NOBJNM; OBJNAM; PEREND; PERSTA; STATUS; **T_HDIF; T_RGFC; T_TDIF; STANUM, TMZNOF**

Set Attribute_B: INFORM; NINFOM; NTXTDS; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Definition:

A co-tidal zone describes an area of similar tidal characteristics derived from co-tidal lines of:

- Time difference between the times of high and low water from the reference station or port; and
- The range ratio to be applied to the tidal heights at the reference station. The range ratio is to be applied to heights above Chart Datum.

References:

Tronvig, K.A, Gill, S.K., undated, Complexities of Tidal Zoning for Key West, FL. This paper was probably presented at a US Hydrographic Symposium. I am sure that Stephen can advise.

Remarks:

The Co-Tidal Zone is an area derived from the intersections of bounding sets of lines being:

Co-Tidal Lines: places at which High Water, in Universal Time (UT), occurs at the same average interval from High Water at the Standard Port; and

Co-Range Lines: places at which the tide has the same average ratio of the range at the Standard Port. These ratios give predictions referred to Chart Datum on the assumption that Chart Datum is at the same tidal level (i.e. LAT) at both the Standard Port and the position for which the prediction is being made.

Distinction:

Data Encoding Example

Refer to Tronvig and Gill paper, Figure 4, tidal polygon zone KEY501:

OBJNAM = KEY WEST
STANUM (mandatory) = 8724580
T_RGFC (mandatory) = 1.03
T_TADJ (mandatory) = -0054
TMNZNOF (mandatory) = -0500

TIDE – TIME SERIES (T_TIMS)

Recommended Change Summary

The existing S57 point object requires new or modified attributes as follows:

- **VERDAT** – **existing** S57 attribute to define the vertical datum of the time series data – **only required when the data is not the same as Chart Datum** (e.g. height data is transmitted from a transmitting tide gauge and the height is not referenced to Chart Datum)
- **T_HWLW** – **existing** S57 attribute to define the times and heights of high water and low water. The attribute requires modification to alter the height resolution to 0.01. This allows the resolution of the heights to be improved whilst not requiring any change to the HUNI subfield of the DSPM record or in the HUNITS attribute of the M_UNIT meta object class.
- **T_TSVL** – **existing** S57 attribute to define the tidal heights based on an equal time interval. The attribute requires modification to alter the height resolution to 0.01. This allows the resolution of the heights to be improved whilst not requiring any change to the HUNI subfield of the DSPM record or in the HUNITS attribute of the M_UNIT meta object class.
- **T_CATS** – **new** attribute to define the type of the time series data i.e. constant time interval or times of HW and LW
- **STANUM** – **new** attribute to define the issuing authority's unique station identifier
- **TMZNOF** – **new** attribute to define the time offset of the observations to UT in accordance with ISO 8601:2004.
- **T_ACWL** – requires rethinking. Refer to discussion on data quality.

Object Definition

Acronym: **T_TIMS** Code:

Set Attribute_A: NOBJNM; OBJNAM; T_ACWL; **T_HWLW**; T_TINT; **T_CATS**; **T_TSVL**; TIMEND; TIMSTA; **TMZNOF**; **CAT_TS**; **STANUM;** STATUS; **VERDAT**

Set Attribute_B: INFORM; NINFOM; NTXTDS; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Definition:

Tide - the periodic rise and fall of the surface of the sea, due principally to the gravitational interaction between moon, sun and earth. (adopted from IHO Dictionary, S-32, 5th Edition, 5429)

Tidal heights over time may be approximated by a series of height values either:

- Starting from a specified moment in time and given at regular time intervals; or
- Time and height of high and low waters

References:

INT 1: not specified;

M-4: not specified;

Remarks:

The object “tide - time series” encodes tidal heights at either:

- equal time intervals; or
- times of high waters and low waters.

Distinction: tide - harmonic prediction; tide - non-harmonic prediction;

Data Encoding Examples

1. Equal Time Intervals

For a set of hourly height observations from a port identified as 3795, East London (South Africa), starting at 0000 hours on the 8th December 2009 and ending at 2300 hours on the 8th December 2009, the encoding will be:

OBJNAM = EAST LONDON
STANUM (mandatory) = 3795
T_CATS (mandatory) = 1
T_TINT (mandatory when T_CATS=1) = 60
TIMSTA (mandatory when T_CATS=1) = 20091208T0000
TMZNOF (mandatory) = 0200
TIMEND = 20091208T02300 (field is not mandatory although may be useful as a check to count the number of T_TSVL values)
T_TSVL (mandatory when T_CATS=1) =
0.19,0.41,0.77,1.19,1.56,1.79,1.80,1.60,1.22,0.78,0.40,0.17,0.17,0.38,0.75,1.18,1.59
,1.87,1.95,1.81,1.49,1.08,0.67,0.37

2. High and Low Waters

For a set of high and low water heights from a port identified as 2809, Boston (USA), on the 28th May 2010, as follows:

0506 -0.2
1122 2.8
1713 0.1
2328 3.3

The encoding will be:

OBJNAM = BOSTON
STANUM (mandatory) = 2809
T_CATS (mandatory) = 2
TMZNOF (mandatory) = -0500
T_HWLW (mandatory when T_CATS=2) = 20100528T0506,-0.2,
20100528T1122,2.8,20100528T1713,0.1,20100528T2328,3.3

TIDE – HARMONIC PREDICTION (T_HMON)

Recommended Change Summary

The existing S57 point object requires new or modified attributes as follows:

- **VERDAT** – existing S57 attribute to define the vertical datum of the predicted data – **only required when the data is not the same as Chart Datum**
- **T_ACWL** – requires rethinking. Refer to discussion on data quality.

Object Definition

Acronym: **T_HMON**

Set Attribute_A: NOBJNM; OBJNAM; T_ACWL; T_MTOD; T_VAHC; STATUS; **VERDAT; TMZNOF**

Set Attribute_B: INFORM; NINFOM; NTXTDS; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Definition:

Tide - the periodic rise and fall of the surface of the sea, due principally to the gravitational interaction between moon, sun and earth. (adopted from IHO Dictionary, S-32, 5th Edition, 5429)

Predicted tidal heights may be calculated using parameters (harmonic constituents) and an appropriate calculation algorithm.

References:

INT 1: not specified;

M-4: not specified;

Remarks:

The object “tide – harmonic predictions” encodes parameters for use when predicting tidal heights by harmonic methods.

- AUS - **T_FREQ/T_XDOO** – possible new attribute to define the harmonic frequency or extended Doodson number. If this is included, it could make the prediction package used by the Electronic Charting system less important.

Further guidance from the TWLWG is required for the provision of this data.

Distinction: tide – time series; tide - non-harmonic prediction;

Examples

TIDE – NON-HARMONIC PREDICTION (T_NHMN)

Recommended Change Summary

The existing S57 point object requires new or modified attributes as follows:

- **VERDAT** – existing S57 attribute to define the vertical datum of the predicted data – **only required when the data is not the same as Chart Datum**
- **T_ACWL** – requires rethinking. Refer to discussion on data quality.
- **T_THDF** is replaced by **T_TADJ** and **T_HADJ**

Object Definition

Acronym: **T_HMON**

Set Attribute_A: NOBJNM; OBJNAM; T_ACWL; T_MTOD; **T_TADJ**; **T_HADJ**; STATUS; **VERDAT; TMZNOF**

Set Attribute_B: INFORM; NINFOM; NTXTDS; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Definition:

Tide - the periodic rise and fall of the surface of the sea, due principally to the gravitational interaction between moon, sun and earth. (adopted from IHO Dictionary, S-32, 5th Edition, 5429)

Predicted tidal heights may be calculated using time and height differences with respect to a reference port (and associated tidal predictions).

References:

INT 1: not specified;

M-4: not specified;

Remarks:

The object “tide – non harmonic predictions” encodes information for use when predicting times and heights for high and low waters by non-harmonic methods.

Further guidance from the TWLWG is required for the provision of this data.

Distinction: tide – time series; tide - non-harmonic prediction;

TIDAL HEIGHTS - ATTRIBUTES

Chart Datum to Tide Gauge Zero Difference (CD2TGZ)

Recommended Change Summary

This is a **new** attribute that defines the height difference between Chart Datum (CD) and the Tide Gauge Zero (TGZ) levels.

Attribute Definition

Attribute: Chart Datum to Tide Gauge Zero Difference

Acronym: **CD2TGZ**

Attribute type: F

Indication:

The one-dimensional difference in height between Chart Datum (CD) and Tide Gauge Zero (TGZ).

- Where CD is above TGZ, the height difference is a positive number.
- Where CD is below TGZ, the height difference is a negative number.

The height difference is to be given in metres or feet (xx.xxx) with a resolution of 0.001 metres or 0.001 feet

Units: defined in the HUNI subfield of the DSPM record or in the HUNITS attribute of the M_UNIT meta object class, e.g. metre (m)

Format:

xx.xxx

Examples:

Height difference of 1.202 metres where the height of CD is above the height of TGZ:

1.202

Height difference of 0.005 metres where the height of CD is below the height of TGZ:

-0.005

Remarks:

None

Station Identifier (STANUM)

Recommended Change Summary

This is a **new** attribute that defines the Tide Station identifier or number. The identifier should be unique within each Producing Authority.

Attribute Definition

Attribute: Station Number

Acronym: **STANUM**

Attribute type: S

Definition:

The station/port number or identifier assigned by the Producing Authority.

References:

Examples:

STANUM = 55980 Lae, PNG (Australia)
STANUM = 890 Islote Pollo (Chile)
STANUM = 709 Galway (United Kingdom)

Remarks:

The attribute Station Number should correspond to the port/station number published by the Producing Authority in their National Tide Tables (e.g. Australia's station number 59450 in the ANTT).

The Station Number should also correspond to the station name (encoded in the OBJNAM, NOBJNAM attribute) listed by the Producing Authority (e.g. ANTT station number 59450 is named BUGATTI REEF).

The Producing Authority's Agency code is encoded in the S-57 AGEN subfield.

For Discussion:

Not all HO's that publish National Tide Tables issue Station Identifiers – some only show the Station Name (i.e. location).

Category of Tidal Station (CATTDS)

Recommended Change Summary

This is a **new** attribute that defines the Category or type of Tidal Station.

Attribute Definition

Attribute: Category of Tidal Station

Acronym: **CATTDS**

Attribute type: L

Expected input:

ID	Meaning
1:	Major/Standard Station/Port
2:	Minor/Secondary Station/Port
3:	Quasi-Standard Station/Port
4:	Tidal Stream/Current Station
5:	Transmitting

Definitions:

Standard Station/Port: A Station of Port where tidal height data and/or predictions are based on continuous observations of the tide over a period of at least one year.

Secondary Station/Port: A Station or Port where tidal height data and/or predictions are based generally on short-term observations.

Quasi-Standard Station/Port: A Standard Station or Port where tidal height data and/or predictions are deemed suitable for use by a State authority (Australia)

Tidal Stream/Current Station: A Station where tide stream or current measurements exist.

Transmitting: A Station or Port where tidal height or stream data is transmitted via a communication protocol.

Examples:

A Standard Station that also transmits height data is encoded as:

CATTDS = 1,5

A Secondary Station that also has tide stream data is encoded as:

CATTDS = 2,4

Remarks:

The attribute “Category of Tidal Station” encodes the type of tidal station or port.

Discussion Notes:

- ***I have made the attribute type a LIST (L) type which allows multiple values to be encoded.***
- ***Do height stations also provide tidal stream data or are they identified separately (i.e different station names or identifiers)?***

AUS – Currently has a location that transmits both tidal heights and tidal streams with the same name (Nardana Patches, Torres Strait). The VHF broadcast gives them unique 2 character identifier and currently have unique station numbers (this may change in the future).

Time Zone Offset (TMZNOF)

Recommended Change Summary

This is a **new** attribute that encodes the Time Zone Offset from Universal Coordinate Time (UTC) to local time.

Attribute Definition

Attribute: Time Zone Offset

Acronym: **TMZNOF**

Attribute type: A

Indication:

- Time zone offset in hours and minutes: hhmm (according to ISO 8106:1988)
- Where the local time zone is East of Greenwich, the time zone offset is hhmm. The + symbol is NOT to be encoded in the data
- Where the local time zone is West of Greenwich, the time zone offset is a negative (-) value i.e. -hhmm

Format:

+/- hhmm

Examples:

The time zone offset for a Station at Sydney, Australia is +1000, hence:

TMZNOF = 1000

The time zone offset for a Station at Durban, South Africa is +0200, hence:

TMZNOF = 0200

The time zone offset for a Station at the Cocos Islands, Indian Ocean is +0630, hence:

TMZNOF = 0630

The time zone offset for a Station at New York, USA is -0500, hence:

TMZNOF = -0500

Remarks:

- Daylight Saving time is not included in the offset value.
- **The sign convention in accordance to ISO 8106:1988 is the reverse of current zone offset values whereby the offset is based on the local time being the reference time.**

Category of Time Series (T_CATS)

Recommended Change Summary

This is a **new** attribute that defines the Category or type of Time Series data.

Attribute Definition

Attribute: Category of Time Series

Acronym: **T_CATS**

Attribute type: E

Expected input:

ID	Meaning
1:	Constant time interval
2:	High and Low Water times

Definitions:

Constant time interval: The time interval between data values is constant e.g. 1 minute, 15 minutes, 60 minutes (hourly)

High and Low Water times: The time series provides data for high and low waters and hence the time interval between data is not constant

Remarks:

The attribute Category of Time Series encodes whether data is based on a constant time interval or on the high and low water times

Tide - High and Low Water Values (T_HWLW)

Recommended Change Summary

This is an **existing** attribute that encodes the times and heights of high and low waters for each day of the duration of the time series. The recommended change for this attribute is:

- Alter the height resolution from 0.1m to 0.01m

Attribute Definition

Attribute: Tide – High and Low Water Values

Acronym: **T_HWLW**

Attribute type: A

Indication:

Dates/times and heights are to be encoded in pairs, each value separated by a comma.

The date/time should be encoded using 4 digits for the calendar year (CCYY), 2 digits for the month (MM) (eg April = 04) and 2 digits for the day (DD), separated by a capital T from the hour (hh) and minutes (mm) which should each be encoded using 2 digits. This conforms to ISO 8601:2004. Seconds should not be used.

Time is given at Local Time.

The height should be given in metres (xx.xx) with a resolution of **0.01** metre.

Format:

CCYYMMDDThhmm,xx.xx,CCYYMMDDThhmm,xx.xx

Example:

19950428T1020,1.02,19950428T1455,4.98,...

Remarks:

The attribute “tide - high and low water values“ encodes information on the times and heights of high and low waters for each day for the duration of the time series.

Tide – Co-Tidal Range Factor (T_RGFC)

Recommended Change Summary

This is a **new** attribute that encodes the Co-Tidal range factor to be applied to the height differences within a particular area.

Attribute Definition

Attribute: Co-Tidal Range Factor

Acronym: **T_RGFC**

Attribute type: F

Format:

xx.xx

Examples:

The range factor of 1.02 to be applied to height differences is:

T_RGFC = 1.02

Remarks:

No remarks.

Tide – Time Difference (T_TDIF)

Recommended Change Summary

This is a **new** attribute that encodes the time difference for a particular area to be applied to the times of High and Low Water at the reference Station or Port.

Attribute Definition

Attribute: Tide - Time Differenece

Acronym: **T_TDIF**

Attribute type: F

Indication:

Time difference in hours and minutes: hhmm (according to ISO 8106:1988) and proceeded with a minus sign (-) if the time difference is earlier than the reference station. Where the time difference is later than the reference station, the + sign is not encoded.

Format:

+/- hhmm

Examples:

The time difference where HW or LW is experienced at a place 1 hour and 23 minutes earlier than at the reference station is encoded as:

T_TADJ = -0123

The time difference where HW or LW is experienced at a place 42 minutes later than at the reference station is encoded as:

T_TADJ = 0042

Remarks:

No remarks.

Tide – Time Series Value (T_TSVL)

Recommended Change Summary

This is an **existing** attribute that encodes the tidal heights above or below datum for the duration of a time series. The recommended change for this attribute is:

- Alter the height resolution from 0.1m to 0.01m

Attribute Definition

Attribute: Tide – Time Series Values

Acronym: **T_TSVL**

Attribute type: A

Indication:

The height above or below datum. Where the height is below datum, it is to be shown as a negative number. Do no encoded a + when heights are above datum. Each value is separated by a comma.

The height should be given in metres (xx.xx) with a resolution of **0.01** metre.

Example:

0.20,0.16,0.12,0.06,0.03,0.00,-0.05,-0.08,-0.04,-0.01,0.02,0.06,0.11

Remarks:

The attribute “tide – time series values“ encodes the height values for the duration of the time series.

Tide – Time Interval of Values (T_TINT)

Recommended Change Summary

This is an **existing** attribute that encodes the time interval between values for the duration of a time period. The recommended change for this attribute is:

- Clarify the attribute title by removing the “current” text
- Expand the existing attribute information

Attribute Definition

Attribute: Tide – Time interval of values

Acronym: **T_TINT**

Attribute type: I

Indication:

Unit: Minutes

This attribute is not required to conform to ISO 8601:2004. Seconds should not be used.

Example:

For a time interval between time series data of 1 minute:

T_TINT = 1

For a time interval between time series data of 15 minutes:

T_TINT = 15

For a time interval between predictions of 1 hour (60 minutes):

T_TINT = 60

Remarks:

The attribute “tide – time interval of values” encodes the time interval in minutes between the values in any time series such as tidal heights, tide streams or other data.

Tide – Method of Tidal Prediction (T_MTOD)

Recommended Change Summary

This is an **existing** attribute that encodes the method of tidal prediction. There are no changes required to this attribute, however some clarification may be useful to improve interpretation (see discussion).

Attribute Definition

Attribute: Tide – method of tidal prediction

Acronym: **T_MTOD**

Attribute type: E

Expected input:

ID Meaning

1 : simplified harmonic method of tidal prediction
2 : full harmonic method of tidal prediction
3 : time and difference non-harmonic method

Definitions:

Simplified harmonic method of tidal prediction: Prediction of tidal heights by combining a simplified set of harmonic constituents into a single time/height curve.

Full harmonic method of tidal prediction: Prediction of tidal heights by combining a complete set of harmonic constituents into a single time/height curve

Time and Height Difference non-harmonic method: Prediction of high and low water times and heights by modification of the high and low water times and heights of a known time/height curve.

Remarks:

The attribute “Tide – method of tidal prediction” encodes the various methods of tidal prediction.

Discussion:

Should the IHO be giving some guidance on the preferred methods to use e.g. minimum number of constituents in relation to accuracy requirements, preferred or endorsed algorithms, etc.

For example, for the Simplified harmonic method, add “This method uses the four main constituents (M2, S2, K1, O1) and the Tidal Angles and Factors. Predictions will be accurate to 10% of the tidal range.”

Tide – Height Differences (T_HDIF)

Recommended Change Summary

This is a **new** attribute that encodes the tidal height difference comparative to a reference station.

S-57 currently has an attribute **T_THDF (Tide – Time and Height Differences)** and it is proposed that this attribute be replaced by two **new** attributes **T_TDIF** (time difference) and **T_HDIF** (height difference) to enable the attributes to be used in different objects.

The requirement, structure and content of this attribute needs to be considered in terms of whether or not this data is provided in S-57/S-100 or as part of a digital tide table product. Restrictions on provision of this data as well as the way in which it is to be used (i.e. algorithms, perceived data quality, end-user or manufacturer, timezone (local and/or zulu), relationship to provision of data using a co-tidal model (T_COTZ object), etc) require further discussion.

Attribute Definition

Attribute: Tide – height differences

Acronym: **T_HDIF**

Attribute type: A

Indication:

Data is encoded in comma separated pairs where:

- First value is the Height difference for mean high water
- Second value is the Height difference for mean low water

The height difference is to be given in metres or feet (xx.xx) with a resolution of 0.01 metres or 0.01 feet

Units: defined in the HUNI subfield of the DSPM record or in the HUNITS attribute of the M_UNIT meta object class, e.g. metre (m)

Example:

Based on a reference station, the height differences are encoded as:

-0.72,0.91

Tide – Value of Harmonic Constituents (T_VAHC)

Recommended Change Summary

This is an **existing** attribute that encodes a set of harmonic constituents.

The requirement, structure and content of this attribute needs to be considered in terms of whether or not this data is provided in S-57/S-100 or as part of a digital tide table product. Restrictions on provision of this data as well as the way in which it is to be used (i.e. algorithms, perceived data quality, end-user or manufacturer, timezone (local and/or zulu), etc) require further discussion.

Attribute Definition

Attribute: Tide – value of harmonic constituents

Acronym: **T_VAHC**

Attribute type: A

Definitions:

Harmonic constituents are the harmonic elements in a mathematical expression for the tide producing force and in the corresponding formula for the tidal curve. Each constituent represents a periodic change or variation in the relative positions of the earth, moon and sun.

Indication:

- The first is the number of columns (C, always 2)
- The second is the number of rows (R).
- The next value(s) (C, always 2) indicates the name(s) of the columns
- The next value(s) (R times) indicates the name(s) of the rows (i.e. constituents).
- Then follows the values (C x R times) of amplitude and phase.
- All values are comma separated

Example:

The following table shows the “amplitude” and “phase” for the four main constituents. Hence:

C = 2
R = 4
C x R = 8 (there will be 8 numeric values)

	Amplitude (m)	Phase (°)
M2	0.962	165
S2	0.361	243
K1	1.223	097
O1	0.875	143

The encoding of the above data is:

2,4,AMPLITUDE,PHASE,M2,S2,K1,O1,0.962,165,0.361,243,1.223,097,0.875,143

Remarks:

The attribute “Tide – value of harmonic constituents” contains a 2 dimensional array of harmonic constituent values.