



**S-101PT8-22**

# **Depth Resolution in S-101 ENC's**



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# CURRENT IHO STANDARDS FOR DEPTH UNITS (1)

International  
Hydrographic  
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## S-4:

### B-130 UNITS

The standard units for **depths** and **heights** must be metres (m) and decimetres (dm).

The standard units for **positional accuracy** must be metres (m).

The standard units for **distance** 'on the ground' must be nautical miles (M) and cables, or metres (m).

The standard units for **dimensions of charts** must be millimetres (mm).

The standard units for **time** must be hours (h), minutes (min or m) and seconds (sec or s), referred to Universal Time Co-ordinated (UTC).

The standard units for **speed** must be knots (kn).

The standard units for **geographical positions** should be degrees (°) minutes (') and decimals of a minute. Degrees (°), minutes (') and seconds (") may be used if appropriate.

The standard units for **bearings**, such as for a recommended track or magnetic variation, should be degrees (°) and decimals of a degree. Degrees (°) and minutes (') may be used if appropriate.

**NOTE:** This specification was reconfirmed at the NCWG7 Remote Meeting – 24-25 November 2021.

### B-412 SOUNDINGS

Charted soundings must represent the depth measured from Chart Datum to the sea floor placed in such a way that the centre of gravity (geometric centre) of the set of numerals coincides with the position referred to.

**Rounding of depths**, including drying heights, must always be on the safe (shoaler) side (that is: soundings must be rounded down and drying heights rounded up, if necessary). The rounding should be:

For depths

- to the nearest decimetre between 0,1 and 21m:  
0,001 to 0,099 rounds **down** to nearest decimetre for example: a recorded depth of 4,38m rounds down to 4,3m.
- to the nearest half metre from 21 to 31m:  
0,001 to 0,499 rounds **down** to 0,0 for example: a recorded depth of 23,49 rounds down to 23m;  
0,500 to 0,999 rounds **down** to 0,5 for example: a recorded depth of 23,51 rounds down to 23,5m.
- thereafter, to the nearest metre:  
0,001 to 0,999 rounds **down** to 0,0 for example: a recorded depth of 31,85m rounds **down** to 31m.

For drying heights

- to the nearest decimetre:  
0,001 to 0,099 rounds **up** to nearest decimetre for example: a recorded drying height of -2,32m rounds **up** to -2,4m

However, these soundings must be adjusted as a function of the degree of accuracy with which depths were actually measured, so that the precision with which soundings are recorded on charts can never be misleading as to the accuracy of such soundings.



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# CURRENT IHO STANDARDS FOR DEPTH UNITS (2)

International Hydrographic Organization

## S-57: (Appendix A, Chapter 2)

Attribute: Value of sounding

Acronym: VALSOU

Code: 179

Attribute type: F

### Definition:

The value of the measurement of a sounding relative to the chart datum.

### References:

INT 1: II 10, 11, 14, 15;

M-4: 410; 412 413.1;

### Indication:

Unit: defined in the DUNI subfield of the DSPM record or in the DUNITs attribute of the M\_UNIT meta object class, e.g. metre (m)  
Resolution: 0.1 m or 0.1 fm or 0.1 ft

### Format:

sxxxxx.xx  
s: sign, negative values only.

### Examples:

18.2 for a sounding of 18.2 metres.  
-2.4 for a drying height of 2.4 metres.

## S-57: (Appendix B.1, clause 4.4) (= S-4)

Depths are converted from decimal meters to integers by means of the A3-D (Sounding) Multiplication Factor  $\equiv$  [SOMF] subfield value in the AData Set Parameter  $\equiv$  [DSPM] field. The integer values are encoded in the A3-D (Sounding) Value  $\equiv$  [VE3D] subfield. Soundings are never encoded with a resolution greater than one decimeter, so the value of SOMF must be 10 encoded in binary form.

(= S-4)

( $\neq$  S-4)





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# CURRENT IHO STANDARDS FOR DEPTH UNITS (3)

International Hydrographic Organization

## S-101: (≠ S-4)



### 10.1.2 Encoding of Depths

Depths are converted from decimal metres to integers by means of the [CMFZ] (see Annex B – clause B5.1.2). This Product Specification limits the resolution to two decimal places and therefore the [CMFZ] must be set to {100}.

EXAMPLE: A depth = 4.2 is converted in  $Z = \text{depth} * \text{CMFZ} = 4.2 * 100 = 420$

## S-101: (Annex A)

(≠ S-4)



27.183 value of sounding (VALSOU)

**Value of sounding:** IHO Definition: The value of the measurement of a sounding relative to the chart datum. (S-57 Edition 3.1, Appendix A – Chapter 2, Page 2.232, November 2000).

Attribute Type: Real

Unit: Defined as an attribute in the ENC dataset metadata: metre (m)

Resolution: 0.01m

Format: sxxxxx.xx  
s: sign, negative values only

Examples: **18.20** for a sounding of 18.2 metres  
**-2.46** for a drying height of 2.46 metres

Remarks:

- A drying height is indicated by a negative value.

27.85 depth range minimum value (DRVAL1)

(= S-4)

**Depth range minimum value:** IHO Definition: Depth range is the depth from a specified sounding datum as a depth interval bounded by the minimum (shoalest) and maximum (deepest) depth values. (Defence Geospatial Information Working Group; Feature Data Dictionary Register, 2010).

**depth range minimum value** defines the minimum (shoalest) value of a depth range. (S-57 Edition 3.1, Appendix A – Chapter 2, Page 2.124, November 2000).

Attribute Type: Real

Unit: Defined in the AXUM subfield of the CSAX record: metre (m)

Resolution: 0.1m

Format: sxxxxx.x  
s: sign, negative values only

Example: **50** for a minimum depth of 50 metres

Remarks:

- Where the area dries, the value is negative.



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# ACCURACY OF DEPTHS ON CHARTS (ZOC)

International Hydrographic Organization

ZOC Table:

1	2	3		4	5
ZOC <sup>1</sup>	Position Accuracy <sup>2</sup>	Depth Accuracy <sup>3</sup>		Seafloor Coverage	Typical Survey Characteristics <sup>5</sup>
A1	± 5 m + 5% depth	= 0.50 + 1% d		Full area search undertaken. Significant seafloor features detected <sup>4</sup> and depths measured.	Controlled, systematic survey <sup>5</sup> high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10	± 0.6		
		30	± 0.8		
		100	± 1.5		
		1000	± 10.5		
A2	± 20 m	= 1.00 + 2% d		Full area search undertaken. Significant seafloor features detected <sup>4</sup> and depths measured.	Controlled, systematic survey <sup>5</sup> achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder <sup>6</sup> and a sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10	± 1.2		
		30	± 1.6		
		100	± 3.0		
		1000	± 21.0		
B	± 50 m	= 1.00 + 2% d		Full area search not achieved; uncharted features, hazardous to surface navigation are not expected but may exist.	Controlled, systematic survey achieving similar depth but lesser position accuracies than ZOCA2, using a modern survey echosounder <sup>6</sup> , but no sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10	± 1.2		
		30	± 1.6		
		100	± 3.0		
		1000	± 21.0		
C	± 500 m	= 2.00 + 5% d		Full area search not achieved, depth anomalies may be expected.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.
		Depth (m)	Accuracy (m)		
		10	± 2.5		
		30	± 3.5		
		100	± 7.0		
		1000	± 52.0		
D	worse than ZOC C	Worse Than ZOC C		Full area search not achieved, large depth anomalies may be expected.	Poor quality data or data that cannot be quality assessed due to lack of information.
U	Unassessed - The quality of the bathymetric data has yet to be assessed				

1	2	3		4	5
ZOC <sup>1</sup>	Position Accuracy <sup>2</sup>	Depth Accuracy <sup>3</sup>		Seafloor Coverage	Typical Survey Characteristics <sup>5</sup>
A1	± 5 m + 5% depth	= 0.50 + 1% d		Full area search undertaken. Significant seafloor features detected <sup>4</sup> and depths measured.	Controlled, systematic survey <sup>6</sup> high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10	± 0.6		
		30	± 0.8		
		100	± 1.5		
		1000	± 10.5		

## S-4: (B-412)

However, these soundings must be adjusted as a function of the degree of accuracy with which depths were actually measured, so that the precision with which soundings are recorded on charts can never be misleading as to the accuracy of such soundings.



### 10.1.2 Encoding of Depths

Depths are converted from decimal metres to integers by means of the [CMFZ] (see Annex B – clause B5.1.2). This Product Specification limits the resolution to two decimal places and therefore the [CMFZ] must be set to {100}.

EXAMPLE: A depth = 4.2 is converted in Z = depth\*CMFZ = 4.2\*100 = 420





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# PROPOSED AMENDMENTS TO S-4 (NCWG)

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Action from NCWG7 (24-25 November 2021): Draft S-4 redlines to be considered by NCWG via NCWG letter. Refer to Paper NCWG7-06.4A.

## B-412 SOUNDINGS

Charted soundings must represent the depth measured from Chart Datum to the sea floor placed in such a way that the centre of gravity (geometric centre) of the set of numerals coincides with the position referred to.

The standard units of measure for the display of depths, including drying heights, on charts must be metres (m) and decimetres (dm) (see B-130).

**Rounding of depths**, including drying heights, must always be on the safe (shallower) side (that is: soundings must be rounded down and drying heights rounded up, if necessary). The rounding should be:

For depths

- to the nearest decimetre between 0,001 and 21m:  
0,001 to 0,099 rounds **down** to the nearest decimetre. For example: a recorded depth, adjusted to Chart Datum, of 4,38m rounds down to 4,3m.
- to the nearest half metre between 21,001 and 31m\*:  
0,001 to 0,499 rounds **down** to 0,0. For example: a recorded depth, adjusted to Chart Datum, of 23,49m rounds down to 23m;  
0,501 to 0,999 rounds **down** to 0,5. For example: a recorded depth, adjusted to Chart Datum, of 23,81m rounds down to 23,5m.
- ~~thereafter~~, to the nearest metre from 31,001m:  
0,001m to 0,999 rounds **down** to ~~0,0~~ the nearest metre. For example: a recorded depth, adjusted to Chart Datum, of 31,85m rounds down to 31m.

\* Soundings sourced from high order surveys using modern survey techniques may be of a degree of accuracy such that the depths between 21,001 and 31m may be rounded down to the nearest decimetre as for depths up to 21m.

For depths stored in a source bathymetric database, the above rounding conventions equate to truncating the stored depth values to the required resolution. For ENC where depths may be stored in the dataset to the nearest centimetre, all numbers after the second decimal place of a metre should be truncated. For display of these depths in ECDIS, rounding to the nearest decimetre should be applied between 0.001 and 31m; and to the nearest metre from 31.001m, in accordance with the above rounding conventions.

For drying heights

- to the nearest decimetre:  
0,001 to 0,099 rounds **up** to the nearest decimetre. For example: a recorded depth, adjusted to Chart Datum, of -2,32m rounds up to -2.4m.

For depths stored in a source bathymetric database, the above rounding conventions equate to truncating the stored depth values to the required resolution and adjusting the resolved value up by one where any removed integer is non-zero. For ENC where drying heights may be stored in the dataset to the nearest centimetre, the second decimal place of a metre should be rounded up if required (for example, -2.321m rounds up to -2.33m). For display of these drying heights in ECDIS, rounding up to the nearest decimetre should be applied in accordance with the above rounding convention.

However, these soundings must be adjusted as a function of the degree of accuracy with which depths were actually measured, so that the precision with which soundings are recorded on charts can never be misleading as to the accuracy of such soundings.



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# STORAGE (ENCODING) V DISPLAY

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A decision is required as to whether the specification to represent depths in metres and decimetres is to be implemented at the data capture level or at the portrayal level:

- Encoding: Amending [CMFZ] to {10} to reflect decimetre resolution of depths in ENC; and ensuring any S-101 attributes that quote depth information (for example valueOfSounding) also have decimetre resolution; or
- Portrayal: Retaining [CMFZ] = {100} and including S-101 portrayal rules such that all displayed depths, including depths that may be included in the ECDIS Pick Report, are displayed in metres and decimetres.

**Recommendation 1:** That the S-101PT determine the most appropriate method for ensuring conformance with the specifications for the depiction of depths on charts as mandated in S-4, as summarised above, and apply this methodology to S-101.



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## RECOMMENDATIONS (2)

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**Recommendation 2:** If the decision for recommendation 1 is in line with the portrayal option, S-101PT to develop portrayal rules such that all depths are displayed to decimetre resolution; and ensure these rules are documented in the appropriate location.

**Recommendation 3:** That the S-101PT discuss any requirement that may be relevant to justify depiction of any depth information derived from ENC data in ECDIS to greater than decimetre resolution. It is suggested that any such discussion should also involve the NCWG and DQWG. If any such requirement is identified, this should be communicated to the NCWG so that appropriate action can be taken to update S-4.

**Recommendation 4:** That the S-101PT, through the DCEG Sub-Group, conduct a review of all attributes related to a unit of measure and ensure that there is consistency throughout S-101 in regard to the application of the unit of measure. For depths, this will need to take into account the decision made for the resolution of soundings in ENC data.





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## ACTIONS REQUESTED OF S-101PT

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- 1) **Agree** on a methodology to ensure that all depth depiction from ENC in ECDIS is in metres and decimetres in line with S-4 regulations for the depiction of depths on charts.
- 2) **Discuss** any possible requirement to display depths from ENC in ECDIS to greater resolution than metres and decimetres and initiate any appropriate action, including notification to the NCWG for possible amendments to S-4.
- 3) **Instruct** the DCEG Sub-Group to review the resolution of all attributes related to a unit of measure to ensure consistency within the S-101 ENC Product Specification.



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**THANK YOU**

S-101PT8 Remote Meeting 06-07 December 2021