



Guidelines and recommendations for the population of CATZOC values from survey data



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HSSC ASSIGNED TASK TO THE DQWG

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- DQWG Terms of Reference:
Provide guidance on data quality aspects to Hydrographic Offices, in particular to ensure harmonized implementation
- DQWG produced S-67: Mariner's Guide to Accuracy of Depth Information in Electronic Navigational Charts (Edition 1.0.0, September 2020) – CL33/2020 refers.
- Comment Philippines: We support for the improvement of our nautical charting and hydrographic survey system
- Comment Uruguay: SOHMA considers this new Standard as a very valuable publication for the international community. Also, it will be adopted by Cartography team of SOHMA. The standard will contribute to ease the training process for all the compilers due to the gathered information contained within it.



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S-44 Edition 6.0.0 (September 2020)

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Guidelines to translate S-44 data into S-101 CATZOC

- Several DQWG Member States provided their national methodologies from survey data to CATZOC values

Member State	Used values	Other source	Usage band dependant	Downgrading	Comments
Australia	A1, A2, B, C, D	Not specified	No information	No	CATZOC C is too wide
Brazil	A1, A2, B, C, D, U	Not specified	No information	No	Digitization from paper
Finland	A1, A2, B, C, U	Not specified	No information	No	CATZOC ENC=paper
France	A2, B, C, D	Not specified	Yes	No	Matrix ZOC/S-44
Italy	A1, A2, B, C, D, U	Not specified	Yes	Yes	Digitization from paper
Japan	A1, B, C, D, U	Not specified	No information	No	None
Netherlands	A1, A2, B, D	Rijkswaterstaat	No information	Yes	Dynamic seabed
Norway	A1, A2, B, C	Not specified	No information	No	Moving glaciers
UK	A1, A2, B, C, D	Not specified	No information	No	CATZOC U avoided
US	A1, A2, B, C, D	US ACoE / Navy	No information	No	US ACoE -> B value



IHO S-44 order

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Order	Intended usage
Exclusive	Shallow water areas (harbours, berthing areas and critical areas of fairways and channels) where there is an exceptional and optimal use of the water column and where specific critical areas with minimum underkeel clearance and bottom characteristics are potentially hazardous to vessels.
Special	Areas where underkeel clearance is critical. Examples of areas that may require Special Order surveys are: berthing areas, harbours, and critical areas of fairways and shipping channels.
1a	Areas where features on the bottom may become a concern for the type of surface traffic expected to transit the area but where the underkeel clearance is considered not to be critical.
1b	Areas where the types of surface vessels expected to transit the area is such that a general depiction of the bottom is considered adequate.
2	Areas where the depth of water is such that a general depiction of the bottom is considered adequate.



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Order	Requirements
Exclusive	For this order, a 200% feature search and a 200% bathymetric coverage are required. The size of features to be detected is deliberately more demanding than for Special Order.
Special	100% feature search and 100% bathymetric coverage are required and the size of the features to be detected by this search is deliberately more demanding than for Order 1a.
1a	A 100% feature search is required in order to detect features of a specified size. Bathymetric coverage less than or equal to 100% is appropriate as long as the least depths over all significant features are obtained and the bathymetry provides an adequate depiction of the nature of the bottom topography.
1b	As a minimum, an evenly distributed bathymetric coverage of 5% is required for the survey area. This means some features will not be detected, although the distance between areas of bathymetric coverage will limit the size of those features.
2	As a minimum, an evenly distributed bathymetric coverage of 5% is required for the survey area. Recommended for areas deeper than 200 meters.



IHO S-44 terms [1]

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Term	Description
Bathymetric coverage	Extent to which an area has been surveyed using a systematic method of measuring the depth and is based on the combination of the survey pattern and the theoretical area of detection of the survey instrumentation.
Confidence level	Probability that the true value of a measurement will lie within the specified uncertainty from the measured value
Feature	Any object, whether natural or manmade, which is distinct from the surrounding area.
Feature detection	Ability of a system to detect features of a defined size.
Feature search	Extent to which an area has been surveyed using a systematic method of identifying features.



IHO S-44 terms [2]

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Term	Description
Reduced depth	Observed depth including all corrections related to the survey, post processing, and reduction to the appropriate vertical datum.
Significant Feature	Feature that poses a potential danger to navigation or object one would expect to see depicted on a nautical chart or product.
Total horizontal uncertainty (THU)	Component of total propagated uncertainty (TPU) calculated in the horizontal dimension. THU is a two-dimensional quantity with all contributing horizontal measurement uncertainties included.
Total propagated uncertainty (TPU)	Three dimensional uncertainty with all contributing measurement uncertainties included.
Total vertical uncertainty (TVU)	Component of total propagated uncertainty (TPU) calculated in the vertical dimension. TVU is a one-dimensional quantity with all contributing vertical measurement uncertainties included.



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S-44 terms [3]

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Term	Description
Uncertainty	Estimate characterising the range of values within which the true value of a measurement is expected to lie as defined within a particular confidence level. It is expressed as a positive value.
Underkeel Clearance	Distance between the lowest point of the ship's hull and the seabed, riverbed, etc.



IHO S-101 terms

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Feature Type	Attribute	
Quality of Bathymetric Data	Category of temporal variation	(under discussion)
	Data assessment	YES / NO
	<i>Depth range maximum value</i>	<i>Value</i>
	<i>Depth range minimum value</i>	<i>Value</i>
	Features detected	Least depth / significant / <i>size</i>
	Full seafloor coverage achieved	YES / NO
	Horizontal position uncertainty	Uncertainty fixed / <i>variable</i>
	Survey date range	Date end / <i>date start</i>
	Vertical uncertainty	Uncertainty fixed / <i>variable</i>

Italic = optional



IHO S-101 Value

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ZOC	Position accuracy	Depth accuracy	Seafloor coverage
A1	± 5 m + 5% depth	0.50 m + 1% depth	Full area search undertaken. Significant seafloor features detected and depths measured.
A2	± 20 m	1.00 m + 2% depth	Full area search undertaken. Significant seafloor features detected and depths measured.
B	± 50 m	1.00 m + 2% depth	Full area search not achieved; uncharted features hazardous surface navigation are not expected but may exist.
C	± 500 m	2.00 m + 5% depth	Full area search not achieved, depth anomalies may be expected.
D	Worse than ZOC C	Worse than ZOC C	Full area search not achieved, large depth anomalies may be expected.



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Usage bands and required S-44 levels

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UB	Intended usage	Allowable S-44	S-101 ZOC
1	Overview	2	?
2	General	1b, 2	?
3	Coastal	1a, 1b	?
4	Approach	Special, 1a	?
5	Harbour	Special	?
6	Berthing	Exclusive, Special	?



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OBSERVATIONS

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- Is UncertaintyFixed / UncertaintyVariable the same as THU or TVU?
- Is UncertaintyFixed / UncertaintyVariable the same as 95% Confidence Interval?
- Is TVU the same as RMSE? Is THU the same as RMSE?¹
- Does S-44 Order 1a with “Bathymetric coverage less than or equal to 100% is appropriate as long as the least depths over all significant features are obtained and the bathymetry provides an adequate depiction of the nature of the bottom topography” qualify to S-101 ZOC value A1 and/or A2 (full area search undertaken)?

¹RMSE = root mean square error



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DQWG are invited to

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- Note this presentation
- Create a subWG
- Investigate a common methodology to translate the quality of survey (by ship, airplane/helicopter/drone, satellite etc,) into an appropriate Quality of Bathymetric Data value (CATZOC)
- Investigate the impact of different Usage Bands and S-101 ENC scheming
- Take any other actions as considered appropriate
- Report to the DQWG