

ADOPTION OF EDITION 6.2.0 of S-44 – IHO STANDARDS FOR HYDROGRAPHIC SURVEYS

References:

- A. IHO CL 35/2024 dated 1 October 2024 – *Call for the approval of edition 6.2.0 of S-44 - IHO Standards for Hydrographic Surveys*
- B. IHO Resolution 2/2007 as amended – *Principles and Procedures for making changes to IHO Technical Standards and Specifications.*

Dear Hydrographer,

1. The approval of Member States of Edition 6.2.0 of S-44 - *IHO Standards for Hydrographic Surveys* was requested by IHO Circular Letter in Reference A in application of the process for the development and maintenance of technical standards (Reference B).
2. The Secretariat would like to thank the following 42 Member States that replied to Reference A: Algeria, Australia, Bangladesh, Belgium, Canada, Chile, Columbia, Croatia, Cuba, Cyprus, Denmark, Estonia, Fiji, Finland, France, Germany, Greece, Guatemala, Iran (Islamic Republic of), Ireland, Italy, Jamaica, Japan, Latvia, Malaysia, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Poland, Portugal, Romania, Russian Federation, Singapore, Slovenia, Spain, Sweden, United Kingdom of Great Britain and Northern Ireland, United States of America and Venezuela.
3. Edition 6.2.0 of S-44 received unanimous approval, with six Member States making comments (Bangladesh, Colombia, New Zealand, Russian Federation, Singapore and Spain). These comments and the outcome of their review by the Working Groups and Project Team Chairs and Secretariat are provided in Annex A to this Circular Letter.
4. When Reference A was issued, there were 100 Member States of the IHO with three States suspended. In accordance with the provisions of the Convention on the IHO, the minimum number of affirmative votes required is 31. As a result, Edition 6.2.0 of S-44 has been adopted.
5. The final version of Edition 6.2.0 of S-44 will be published on the IHO website > Publications > Standards and Specifications (<https://iho.int/en/standards-and-specifications>).

On behalf of the Secretary-General

Yours sincerely,

John NYBERG
Director

Annex A: Members' responses to IHO CL 35/2024 and comments from the WGs Chairs and IHO Secretariat

**MEMBER STATES' RESPONSES TO IHO CL 35/2024 AND COMMENTS
FROM THE WORKING GROUPS' CHAIRS and IHO SECRETARIAT**

S-44, Ed. 6.2.0	IHO Standards for Hydrographic Surveys
------------------------	---

BANGLADESH (Vote = YES)

- A. S-44 provides a comprehensive and essential framework for hydrographic surveys. It outlines the requirements for various survey orders. Even though conducting hydrographic survey in highly dynamic areas as the Ganges delta, meeting S-44 standards become challenging. Applying S-44 standards rigidly in deltaic regions with highly unstable and rapidly changing shorelines, such as in some parts of Bangladesh, presents significant challenges. The coastlines in such areas are subject to constant morphological changes due to the tidal fluctuations, erosion, and sediment deposition processes. Sandbanks shift frequently, and low-tide elevations rise and submerge unpredictably, further complicating the task of maintaining strict compliance with the S-44 survey orders within a short time.
- B. In such environments, the frequency and extent of hydrographic surveys cannot be pre-determined in the same way as in more stable regions. The dynamic nature of the delta, combined with the need to constantly monitor shifting sandbanks and changing tidal zones, requires a far more flexible and adaptive approach to survey planning. The rigid application of Special Order or Order 1 (a) standards, which demand high-resolution data and precision, may be impractical in these circumstances due to the rapidly changing physical conditions.
- C. Moreover, in deltaic regions, factors such as turbidity and high levels of underwater noise significantly reduce the effectiveness of multibeam sonar systems, limiting swath coverage and data quality. These environmental conditions further increase the difficulty of achieving the high standards typically set by the S-44.
- D. Given these challenges, IHO may consider revising or providing additional guidance within S-44 for deltaic regions with similarly dynamic and unstable coastlines. A more tailored approach to survey standards in such regions would not only improve the feasibility of surveys but also enhance the quality and accuracy of the data collected.

Comments by the HSWG Chair and IHO Secretariat:

HSWG acknowledges the challenges of surveying in dynamic, estuarine and deltaic environments. However, we feel in terms of standards, this has more impact on the product standards achieved rather than the survey standards. In terms of S-44, the Matrix provides additional ways to attribute measurement uncertainty and other factors, if needed. HSWG welcome input from Bangladesh in future iterations to consider how improvements may be possible in relations to mapping within estuaries.

COLOMBIA (Vote = YES)

The addition of the terms of a priori uncertainty and a posteriori uncertainty to the glossary, the extension of the concept of the term Total Horizontal Uncertainty and the revision of section 3.8 Nature of the Seabed by expanding the terms acoustic and optical backscatter, useful procedures for

data collection and analysis of bathymetric information through acoustic backscatter, with the objective of identifying the nature of the seabed during hydrographic surveys in ports, especially in anchorage areas, are appreciated.

Otherwise, bottom characterization methods are also appreciated, especially in "Seabed Characterization by Inference Techniques (INF)", using mainly data collected during hydrographic surveys with multibeam or lidar technology.

Comments by the HSWG Chair and IHO Secretariat:

The HSWG Chair and IHO Secretariat thank Colombia for their contribution.

NEW ZEALAND (Vote = YES)

New Zealand thanks the HSWG for their work in producing Ed 6.2.0 of S-44 - IHO Standards for Hydrographic Surveys. We note the work done to clarify points like feature detection, uncertainty etc. and note the new guidance on gridded bathymetry

Comments by the HSWG Chair and IHO Secretariat:

The HSWG Chair and IHO Secretariat thank New Zealand for their contribution.

RUSSIAN FEDERATION (Vote = YES)

As a result of the analysis carried out, the following comments can be given to draft edition 6.2.0 of Publication S-44:

1. All innovations of draft edition 6.2.0 of Publication S-44 are relevant, do not raise objections and can be accepted for approval as the current version of S-44.
2. The last sentence of paragraph 2.7 of draft edition 6.2.0 of Publication S-44 is proposed to be stated as follows:
The 95% confidence level for 2D quantities (e.g. position) is defined as $2.45 \times$ standard deviation where the position standard deviation is approximated as an average of the standard deviation in x and y axis directions.
3. In draft edition 6.2.0 of Publication S-44, issues related to an alternative method for determining level corrections based on high-precision determination of geodetic heights of reference points of tidal gauge stations and chart datums using precision GNSS observations in a geocentric coordinate system known as RTK-tide, have not been sufficiently worked out.
4. In draft edition 6.2.0 of Publication S-44, it is still proposed to use only a test site for a posteriori estimate of the quality of bathymetric survey results. The need to use crosslines of sounding (check sounding lines) when taking a survey of relief, is not mentioned. The need of monitoring the results of post-processing of the relief survey using analysis based on the statistical comparison of the depths of the main lines of sounding and crosslines with respect to a selected category of survey, is not mentioned at all in the sixth edition of S-44.

In our opinion, this obvious drawback of the sixth edition of S-44 IHO Standards should be corrected when preparing the next edition.

Comments by the HSWG Chair and IHO Secretariat:

In response to the points raised by the Russian Federation, the S-44 Chair Team offer the following responses:

1. Noted with thanks
2. The present factor of 2.45 x Standard deviation for calculation of Total Horizontal Uncertainty, is a simplification used since Ed.5 in 2008. In the S-44 Ed. 5 THU was described as: *"The assumption has been made that the uncertainty is isotropic"* (denotes the property of being uniform regardless of direction) followed by: *"This makes a Normal distribution circularly symmetric allowing a single number to describe the radial distribution of errors about the true value."*

In Ed. 6.0.0, and 6.1.0, this was expressed as: *"Within this standard, for ease of use, allowable horizontal uncertainty is assumed to be equal in both dimensions. Therefore, assuming a normal distribution of error, the position uncertainty is expressed as a single number."*

In Ed. 6.2.0 we have clarified that it is the largest of the X or Y standard deviations that should be used in the simplified formula.

When estimating uncertainty, we need to assume the worst case, and in both Ed.5 and 6.0.0/6.1.0 it is described as circularly symmetric/equal in both dimensions.

If the formula $DRMS = \sqrt{\sigma x^2 + \sigma y^2}$ (63% confidence) that can be converted to the radial uncertainty R95 (95% confidence) by multiplication by 1.73, we get the formula $R95 = 1.73 \times \sqrt{\sigma x^2 + \sigma y^2}$.

Assuming the maximum allowed uncertainty for Special Order THU=2m and calculate the allowed RMS uncertainty using the reversed simplified formula, $RMS = \frac{THU_{Allowed}}{2.45}$ gives us the maximum allowed RMS uncertainty $\sigma=0.816m$

To prove that the formulas gives the same result, we use $\sigma=0.816m$ for both x and y in the formula above $R95 = 1.73 \times \sqrt{\sigma x^2 + \sigma y^2}$ we get $R95 = 2m$

What we actually calculate by the use of both formulas is actually a "vector" that when σ x and y is equal it has the length of $1.414 \times \sigma$, in our case 1.15m.

This was discussed at several HSWG meetings, and the consensus was that the current definition was correct, but we do understand the issue raised by Russia. We therefore do not propose any further change at this time but further clarification will be provided within the revised C-13 Manual on Hydrography.

3. We feel that this should be covered in C-13, rather than S-44. We have passed to the MHPT Chair.
4. The importance of crosslines is recognised as part of the quality assurance process. However, such procedural elements are more appropriate to C-13. The present factor of 2.45xStandard deviation for calculation of Total Horizontal Uncertainty, is a simplification used since Ed.5 in 2008. In the S-44 Ed. 5 THU was described as: *"The assumption has been*

made that the uncertainty is isotropic” (denotes the property of being uniform regardless of direction) followed by: “This makes a Normal distribution circularly symmetric allowing a single number to describe the radial distribution of errors about the true value.”

The HSWG Chair and IHO Secretariat thank the Russian Federation for their feedback and encourage participation in the deliberations ahead of the next update to S-44.

SINGAPORE (Vote = YES)

Singapore would like to thank the HSWG for their work in keeping S-44 updated and relevant.

Comments by the HSWG Chair and IHO Secretariat:

The HSWG Chair and IHO Secretariat thank Singapore for their contribution.

SPAIN (Vote = YES)

Spain is interested in translating this publication into Spanish

Comments by the HSWG Chair and IHO Secretariat:

The HSWG Chair and IHO Secretariat thank Spain for their offer.