

Guidelines for IHO S-100 Sea Trial Areas

Edition 1.0.0 – October 2025

IHO



International
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Guidelines for IHO S-100 Sea Trial Areas

Draft Edition 0.1.1 - March 2025

Guidelines for minimum requirements and expected outcomes for IHO S-100 Sea Trial Areas
This guidance is to be used to document S-100 Sea Trial results and provide effective evaluation of
S-100 products and services.

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ABSTRACT

The **IHO S-100 Sea Trial Areas Guidelines** provide a framework for conducting **real-world tests** of S-100-based products and systems. The guidelines outline **minimum requirements**, expected outcomes, and reporting processes to facilitate **structured evaluations** by hydrographic offices, industry stakeholders, and mariners.

An IHO S-100 Sea Trial Area is a designated maritime zone where S-100 datasets and services are tested under operational conditions. These trials aim to:

- Validate product specifications of S-100 standards.
- Assess ECDIS and/or system performance in processing and displaying S-100 datasets.
- Gather user feedback on usability and navigation safety and efficiency.

The success of an S-100 sea trial depends on collaboration among multiple stakeholders, including:

- Hydrographic Offices (HOs) – Provide S-100 datasets, define trial areas, and analyze feedback.
- System Developers – Supply and test ECDIS, PPU or other systems.
- Maritime Operators – Offer vessels and real-world operational insights.
- Mariners and End-Users – Evaluate usability, accuracy, and effectiveness of S-100 datasets.
- Maritime Authorities – Ensure compliance with safety regulations and port coordination.
- Training Organizations – Develop S-100 training content and assist with knowledge transfer.

Sea trials assess five key areas:

1. Product Specifications
2. Data Quality
3. System Performance
4. User Experience
5. Operational Impact

A standardized reporting framework (Annex C) ensures structured documentation of trial results. The consolidated reports are shared with IHO working groups to refine S-100 product specifications.

By testing S-100 products and services under real-world conditions and gathering user feedback, trials contribute to demonstrate the benefits of S-100 products and services, evaluate impact on safety and efficiency of navigation.

Revision history

Date	Edition	Description and changes
December 2024	0.0.1	• First draft
February 2025	0.1.0	• Updated according UK and Canada comments • §3 has been rewritten • Abstract added • First cleaning edition
March 2025	0.1.1	• With clarifications and inputs from IHO secretariat
October 2025	1.0.0	• Approbation by C9 (decision C9/017)

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ABBREVIATIONS AND ACRONYMS

HSSC	Hydrographic Services and Standards Committee
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
HO	Hydrographic Office
IHO	International Hydrographic Organization
ECDIS	Electronic Chart Display and Information System
MS	Maritime Service
OEM	Original Equipment Manufacturer
PPU	Portable Pilot Unit
RENC	Regional ENC coordinating center
S100P	S-100 Open Online Platform

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1 Preface

Practical testing of S-100 based IHO standards plays a crucial role in the validation process, ensuring that these standards are reliable, effective, and fit for purpose. Feedback from testing helps to inform the work of IHO working groups/project teams providing inputs to enhance product specification. By demonstrating their robustness and value through testing, the process contributes to build stakeholder confidence and serves as a catalyst for accelerating the adoption and implementation of these standards across the maritime community.

S-100 Testbed projects (example: Baltic Sea – North Sea as an S-100 testbed, S-100 testbed project conducted by ROK and NOAA, ...) have developed approaches to test technical issues and to demonstrate the practical benefits of S-100 products and services compared with existing nautical publications. A S-100 testbed reporting template (2019) is based on IALA Guideline 1107 (2016). Since, IALA has updated the guideline for planning and reporting of testbeds in the maritime domain.

A testbed is a platform for conducting rigorous, transparent, and replicable testing of scientific theories, computing tools, and new technologies. Widely used across many disciplines, testbeds provide experimental research and development environments that deliver results supporting an evidence base.

IHO (HSSC decision 16/45) endorsed Canada's proposal to designate the St-Lawrence River as an **IHO S-100 Sea Trial Area** for 2025.

The concepts of **S-100 testbed** and **S-100 Sea Trial area** both relate to testing and evaluation processes, they have complementary roles in the development and validation lifecycle:

- Testbed is useful for early stage of development, it ensures that the design has addressed every requirement. Example: A laboratory testbed used to evaluate how S-101 ENC's and S-102 Bathymetric Surface data are integrated and displayed on an ECDIS.
- Sea Trial is useful after testbed validation to confirm operational readiness and gather real-world feedback. Example: Testing S-101 ENC's and S-102 Bathymetric Surface data in a navigational route near a busy port to assess usability in an operational ECDIS.

A testbed might identify that something works technically and the standards are correct but a sea trial might find that for the user this does not work as intended.

2 IHO S-100 Sea Trial Area: definition

An **IHO S-100 Sea Trial Area** is a designated maritime zone used to :

- test and validate products and services based on the S-100 Universal Hydrographic Data Model;
- assess ECDIS and/or other systems performance, when using S-100 products or services;
- demonstrate the benefits of S-100 products and services, evaluate impact on safety and efficiency of navigation; sea trials may involve different use-cases.
- gather end-user feedback on usability and performance.

The minimum requirements of an IHO Sea Trial Area are as follows:

2.1 Geographic Characteristics

To fully understand the benefits of new S-100 products, it is important to consider the geographic characteristics of the sea trial area. The area should include a variety of navigational challenges, such as confined channels, open waters, shallow areas, tidally constrained ports and regions with high traffic density in order to allow multiple navigation scenarios and as many products as possible to be tested. A busy waterway or an area with regular vessel traffic are of particular interest to simulate real-world conditions. An area with a coverage from multiple producers will be beneficial to test consistency of datasets from different sources.

2.2 Availability of S-100 datasets

S-100-compliant datasets must be available in the sea trial area for a given period, including at least two products, one of which must be an ENC. These datasets comply with the applicable product specifications referenced in the IHO Geospatial Information Registry (GI Registry).

The following are examples of products relevant to S-100 Phase1:

- S-101 (Electronic Navigational Charts) + ENC update (ER)
- S-102 (Bathymetric Surface)
- S-104 (Water Levels)
- S-111 (Surface Currents)
- S-124 (Navigational Warnings)
- S-128 (Catalogue of Nautical Products)
- S-129 (Under Keel Clearance Management)
- Other relevant S-100 products.

S-57 ENC may also be provided (in order to test “dual fuel”).

Datasets should be digitally signed and encrypted in compliance with the S-100 Part 15 Data Protection Scheme. The period for which data is available should not be less than 3 months. This data is intended for testing purposes only and is not to be used for navigational purposes.

2.3 Involvement of stakeholders

2.3.1 Stakeholders involved in the definition and the designation of an S-100 Sea Trial Area

An IHO S-100 Sea trial area is initiated by a hydrographic office or a member states and submitted to HSCC via an online form (see application template in Annex B) available on the IHO website. The following elements will be requested: area, background, objective summary (including S-100 products and systems under test), location, start date/time, stakeholders involved, and expected results.

HSSC evaluates and approves proposals for S-100 sea trial areas to ensure they align with the IHO’s objectives. The HSSC report to IHO Council subsequently informs the council of new areas and associated progress.

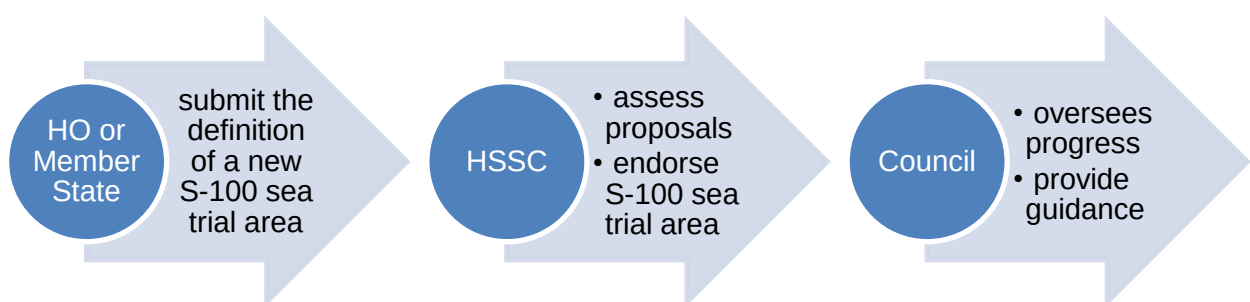


Figure 1 Submission and evaluation process of an S-100 sea trial area

2.3.2 Stakeholders involved in Sea Trials

The success of an S-100 sea trial relies on the active participation of various stakeholders, each playing a crucial role in implementation of S-100 products and systems, ensuring comprehensive testing and

evaluation. The following participants should contribute to different aspects of the trial process:

Hydrographic Offices (HOs) / Member States in charge of the S-100 sea trial area

- Provide S-100 datasets for the proposed trial area;
- Provide guidance on S-100 datasets if necessary;
- Promote the S-100 sea trial area and actively engage with participants to define the scope of the project and the testing;
- Coordinate to ensure collaboration among stakeholders;
- Collect, analyse feedback and share it among appropriate WGs.

Data Distributors

- Collect and deliver datasets to end-users in compliance with the IHO security scheme

System Developers

- Provide the hardware and software required for trials, such as dual-fuel ECDIS systems or PPUs;
- Participate in trials testing systems using S-100 datasets;
- Monitor system performance during trials and address technical issues.

Maritime companies and Operators

- Provide access to vessels and allow equipment like dual-fuel ECDIS or other necessary systems to be tested on board;
- Collaborate on planning realistic trial scenarios;
- Share operational insights and feedback based on trial outcomes;
- Evaluate system usability and benefits for navigation.

Early engagement is key in order to get access to vessels and flexibility is needed.

Maritime training organizations

- Develop training content and integrate S-100 knowledge into formal training programs;
- Develop workshops and simulation exercises to familiarize mariners with S-100 datasets;
- Help define competencies for S-100 system operation.

Maritime Authorities and regulators

Depending on the area, it may be necessary to:

- Grant permissions for conducting trials in national or international waters;
- Ensure compliance with maritime safety and regulatory frameworks, noting that within trials existing solutions would continue to meet the carriage requirements;
- Coordinate with port authorities and navigational services.

Mariners and End-Users

- Participate in trials as end-users to assess the practicality, usability, and accuracy of S-100 products and systems (ECDIS, PPU, ...) in operational scenarios;
- Provide feedback on data, system interface, and overall functionality;
- Identify what training would be needed and which new functions need in depth training;
- Identify the benefits/challenges of adopting S-100 products and services;
- Highlight issues or challenges faced during real-time navigation.

3 Expected outcomes

Conducting S-100 sea trials will provide valuable insights for evaluating product specifications, data quality, system performance, user experience, and operational impact. These trials should include specific tests designed to assess the practical implementation of S-100 products and their effectiveness in real-world maritime operations, ensuring they meet end users' requirements.

The following list of testing is not exhaustive.

3.1 Product Specification

- Verify compliance of S-100 datasets with product specifications.
- Identify potential gaps or ambiguities in existing S-100 product specifications.
- Assess the interoperability between different S-100 product specifications.
- Evaluate how well existing specifications support real-world maritime operations.
- Provide feedback for potential refinements and updates to the standards.

3.2 Datasets provided for the sea trial

- Assess data accuracy and reliability.
- Assess compatibility between different S-100 datasets within the same operational environment.
- Identify potential data consistency issues, especially in multi-source integration.
- Test the update process for S-100 datasets and assess its efficiency and reliability.
- Test cybersecurity measures, such as encryption and digital signatures.
- Test S-128 catalogue supports products discovery, accessibility and updates

3.3 Systems

- Assess the efficiency of all the chain from data delivery to data integration.
- Evaluate performance of ECDIS, ECS or other systems handling S-100 data.
- Test dual-fuel capabilities (S-57 and S-101 coexistence).
- Identify potential bugs, display issues, or system crashes when processing S-100 data.
- Evaluate alarm and alert functionalities for S-100 ECDIS.
- Test how well systems integrate multiple S-100 products for a seamless user experience.

3.4 User Experience & Usability

- Assess the clarity and readability of displayed S-100 information.
- Evaluate mariner workload when using S-100-based navigation.
- Identify any confusion or misinterpretation of S-100 data.
- Gather feedback on user interface improvements needed for ECDIS, ECS or other systems.
- Determine if training requirements are sufficient or if additional education is needed.
- Measure user confidence in decision-making using S-100 datasets.

3.5 Operational Impact

- Assess the impact of S-100 datasets on voyage planning and execution.
- Evaluate whether S-100-based navigation improves situational awareness and decision-making.
- Identify potential safety improvements using S-100 data.
- Assess how S-100 products impact port operations, pilotage, and coastal navigation.
- Test system failures and fallback scenarios when dealing with incomplete or erroneous S-100 data.

These tests will provide feedback for standardization bodies, S-100 data producers, technology developers (OEMs), education and training.

4 Report and feedback

Testing scenarios and results must be captured in a consistent way with documented user requirements in order to support successful implementation of S-100 products and services. It may be relevant to conduct interviews during the trial and to capture and share the end-users wording.

The following standardized reporting framework will be used for all reports, making it easier to compare findings (Annex C).

The online form (MS forms) should be available on S1OOP and the S-100 resources page The reporting template contains the following fields:

- **Name of S-100 Sea Trial Area** : the name should be determined based on relevant considerations of the Sea Trial Areas, either by adding a new one or selecting from the existing lists.
- **Title** : trial name and primary focus
- **Organisation(s)**: name of the responsible organisation(s) for the Sea trial
- **Contact details** (name and email address):
- **Period: (start date / End data / time):**
- **Scenario / user story / use case description** : provide a short description of the user story and specific use cases related (Annex D provide an example of user story)
- **Objectives of the trial** : what are the expected outcomes, what are we seeking to validate, what are the challenges
- **S-100 products and services tested** : list of products or services used during the trial
- **Systems used for the trial** : describe the system used during the trial
- **Summary of outcomes** : provide a summary of the results, challenges encountered, positive effects, ...add attached documents if needed
- **Recommendations for standards improvement** (choose in the list of standards and describe the recommendation for each one): add attached documents if needed
- **Recommendations for data improvement including distribution mechanisms** : add attached documents if needed
- **Recommendations for system improvement** : add attached documents if needed
- **Recommendations for education and training** :
- **Benefits/challenges of adopting S-100 products and services** :
- **Next steps** : do you intend to use S-100 products and services, when ?
- **Other informations** : if needed provide other feedback.

The filled form constitutes the consolidated trial report, shared with all IHO recognized stakeholders. If it contains recommendations for standards improvement, the HO in charge of the sea trial area inform the relevant working group in charge of the affected product specification.

5 Annexes

5.1 Annex A – Definitions

Term	Definition
IHO S-100 Sea Trial Area	An IHO S-100 Sea Trial Area is a designated maritime zone where S-100-based products and systems are tested under real-world conditions or an equivalent virtual environment. It is initiated by a Hydrographic Office or Member State and endorsed by the HSSC to evaluate S-100 products and services, system performance and user experience. The results contribute to refining S-100 standards, improving maritime safety and efficiency, and supporting the transition from S-57 to S-100-based navigation.
Testbed	A testbed is a platform for conducting rigorous, transparent, and replicable testing of scientific theories, computing tools, and new technologies.

5.2 Annex B – Application template for an IHO S-100 Sea trial area

S-100 SEA TRIAL AREA	
BACKGROUND	
OBJECTIVE SUMMARY	
S-100 products under test	
Systems under test	
LOCATION	
PERIOD (START - END)	
STAKEHOLDERS INVOLVED	
RELEVANT IHO WGs/PTs	
EXPECTED RESULTS	

5.3 ANNEX C – Reporting template for an IHO S-100 Sea Trial

NAME OF S-100 SEA TRIAL AREA
TITLE Trial name and primary focus
ORGANISATION(S) Name of the responsible organisation(s) for the Sea trial
CONTACT DETAILS (name and email address)
PERIOD (START DATE / END DATE / TIME)
SCENARIO / USER STORY / USE CASE DESCRIPTION provide a short description of the user story and specific use cases related
OBJECTIVES OF THE TRIAL expected outcomes
S-100 PRODUCTS AND SERVICES TESTED list of products or services used during the trial
SYSTEMS USED FOR THE TRIAL describe the system used during the trial
SUMMARY OF OUTCOMES principal results, challenges encountered, positive effects, ... add attached documents if needed
RECOMMENDATIONS FOR STANDARDS IMPROVEMENT choose in the list of standards and describe the recommendation for each one add attached documents if needed
RECOMMENDATIONS FOR DATA IMPROVEMENT INCLUDING DISTRIBUTION MECHANISMS add attached documents if needed
RECOMMENDATIONS FOR SYSTEM IMPROVEMENT add attached documents if needed
RECOMMENDATIONS FOR EDUCATION AND TRAINING
BENEFITS/CHALLENGES OF ADOPTING S-100 PRODUCTS AND SERVICES
NEXT STEPS do you intend to use S-100 products and services, when?
OTHER INFORMATIONS add attached documents if needed

5.4 ANNEX D - Example of user story with use cases for an IHO S-100 Sea Trial

TITLE AND FOCUS

Enhancing navigation safety in a congested coastal area

As a mariner navigating through a congested coastal area with dynamic environmental conditions, I want to use S-100-based products and services to receive accurate, real-time updates on navigational hazards and dynamic environmental conditions, so I can make informed decisions to ensure safety and efficiency.

USE CASE DESCRIPTION

USE CASE 1: Dynamic environmental data for route optimization

Scenario: A vessel navigates through an area with rapidly changing tides and high currents.

S-100 P&S : S-101 (ENC), S-111 (Surface Currents), S-104 (Water Levels), S-98 (Interoperability).

Expected Outcome:

Feedback on additional information layers display

Feedback on route optimization using these data (reduced fuel consumption, ...).

USE CASE 2 : Safe and efficient port approach to optimize port of call

Scenario: Mariner wants to optimize port of call using high-resolution bathymetric data combined with water levels.

S-100 P&S : S-101 (ENC), S-102 (Bathymetric Surface), S-104 (Water Levels), S-98 (Interoperability).

Expected Outcome:

Feedback on dynamic Safety contour and WLA functions

Feedback on effective optimization of port of call

USE CASE 3 : Integration of Multi-Producer Data

Scenario: Data for the trial area is provided by multiple hydrographic offices.

S-100 P&S : Various interoperable S-100 datasets.

Expected Outcome:

Effective integration ensures no loss of data fidelity and supports informed decision-making.

USE CASE 4 : SAR Event

Scenario: Shore center sends out a SAR-Area. After some time, the shore center modifies the area boundaries, publishes a new message (new geometry and related attributes) and cancels the previous one.

S-100 P&S : S-101 (ENC), S-124 (Navigational Warnings), S-128 (Catalogue of Nautical Products).

Expected Outcome:

Accurate and timely updates are provided.

SAR-area is displayed and updated as an overlay on the ENC.