

Paper for Consideration by S-100WG5

Enhancements to IHO S-64 test datasets in respect of S-100 ECDIS

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Executive Summary:	A Covering paper to a study carried out by IIC Technologies into the scope and content of test datasets required for supporting testing of S-100 enabled ECDIS under the current type approval regime. IHO S-52, IHO S-57, IHO S-101, IHO S-64, IEC 61174, IMO Performance Standard for ECDIS
Related Documents:	for ECDIS
Related Projects:	Development of S-100 enabled ECDIS.

Introduction / Background

This paper provides an overview of the more detailed report compiled by IIC Technologies in respect of the revision and provision of test datasets in support of S-100 ECDIS type approval. It describes a proposed future S-100-enabled ECDIS and testing regime together with an overview of the modifications required by revisions of IHO S-64 which would be reflected in IEC61174. The main paper contains a more detailed description of the current test regime, its major elements and the detail of tests proposed to enhance it in light of the emerging S-100 ECDIS concept.

Analysis/Discussion

In order to understand how test datasets support a future testing regime for an S-100 enabled ECDIS it is first necessary to propose how such an ECDIS should work. Following that is a brief description of the test datasets needed to support a holistic process where the IMO Performance Standard (PS) defines the necessary and generic “operations” of an ECDIS and IEC61174 will then define how candidate equipment is tested against those provisions. IHO standards, as before, support the testing process by providing normative standards for many aspects of the ECDIS operation.

Therefore we propose first an overview of how an S-100 enabled ECDIS could work. Currently this is under development with many of the details within the IHO standards development process and being proposed/developed to the stakeholders in the process.

But the following items represent a “best guess” at some elements of functionality in order to achieve completeness in consideration of required test datasets.

Should the conceptual nature of the S-100 ECDIS change (e.g. not being dual-fuel, no requirement in excess of S-100, abandonment of some areas of machine-readable operation) then the testing specifications and associated datasets can also be adjusted (and the proposed structure should allow this to be done easily). The illustration of the S-100 ECDIS is meant as no more than an illustration at this stage.

The “S-100 ECDIS” concept is in essence:

1. A navigation system that is inherently “dual fuel” in nature¹ – it will deal with both S-100 based navigational products as well as legacy S-57 data presenting a harmonised “side-by-side” display system for the end user

¹ This is a key conceptual point, that the ECDIS is able to ingest, process and present for display a mixture of “legacy” S-57 ENCs as well as S-101 (and other S-10x products). This remains for discussion in terms of both the concept and detail of how the co-existence of S-57 and S-101 shall be achieved in practical terms.

2. The core IMO concept of an ECDIS remains unchanged. Its functionality in IMO terms is the same as that defined in the current IMO PS and which is reflected in the structure and content of the tests specified within IEC61174
3. Compatibility with an arbitrary set of S-100 product specifications which conform to the specifications within IHO S-100. These product specifications form a set of interlocking data products which are used to form the interface with the end user.
 - a. The navigational core of the system is the provision of IHO S-101 data which contains the “equivalent” of the current S-57 database.
 - b. S-101 data can be enhanced with data from (at least) a set of core navigational products. These are defined as (but not restricted to)
 - i. S-101 Electronic Navigational Chart
 - ii. S-102 Bathymetric Surface
 - iii. S-104 Water Level Information for Surface Navigation
 - iv. S-111 Surface currents
 - v. S-129 Under Keel Clearance Management
 - vi. S-122 Marine Protected Areas
 - vii. S-123 Radio Services
 - viii. S-124 Navigational Warnings
 - c. The system can also import, load, display, interrogate, and “use” data from arbitrary² IHO S-100 product specifications. This is done by loading data and a series of catalogues which enable and configure the ECDIS’ compatibility with that data.
4. The user interface and behaviour of the ECDIS is highly configurable. Configurable elements within the system (i.e. those configurable by product specifications defined under S-100) include:
 - a. Feature content, Attribute content, definitions, bindings and textual descriptions
 - b. Portrayal, symbology and colours
 - c. Conditional Symbology processing
 - d. Feature Interrogation (pick report) layout and content
 - e. Features precipitating Alarm/Indication behaviour in the ECDIS.
 - f. Service revision status (the revision status of each piece of data in the system and its individual coverage)
 - g. Context Parameters and Viewing Group titles
 - h. Interoperability (defined under S-98) allows product specifications to interact with each other harmonising the portrayal and function of data in respect of the IMO functionality (e.g. display, alarms/indications, areas for which special conditions exist and route planning). This allows states who wish to issue such enhanced data to end users to have it used as part of the ECDIS’ core functionality.
5. Manufacturer equipment is tested using IEC61174 for type approval certification which references the appropriate parts of S-64 (and other standards where necessary). IHO S-64 forms the key test datasets against which such testing is performed.

² Whether these are indeed arbitrary or whether they form a proper subset of those product specifications definable by S-100. It is conceivable that a profile of S-100s provisions could be used to define compatibility with the S-100 ECDIS to ensure correct operation.

6. S-64 tests “core” functionality against test datasets taken from the list in 3(b) as well as exhaustive S-101 ENC data. It also contains test data sets and catalogues which define an “arbitrary” S-100 test dataset to test its loading, configuration, interoperability and use.
7. S-64 supports testing under IEC61174. It tests functionality related to both S-57 and S-101 data as well as test cases where both are used by the user at the same time (co-existence tests), either for display or combined for route planning or hazard detection. A future revision of both IEC61174 and S-57 can, in theory, remove the purely S-57-based components completely without changing the S-100 tests leaving a purely S-100 test regime.

It should be noted that the detail of this definition of ECDIS operation under S-100 is proposed given the current status and trajectory of the relevant IHO standards but it requires more formal and detailed definition and agreement from the broader community in IHO, IMO and IEC. The current status of this proposal is best described in the recent IHO NCSR paper:

20. In order to maintain ECDIS devices already installed on SOLAS vessels which are technically not ready nor required to be upgraded to S-101 ENC compatibility, and to comply with the applicable IMO regulations pertaining to existing navigation equipment, identical coverage will be provided for S-57 ENCs and S-101 ENCs for a transition period until there is no significant number of legacy systems in the field and all ECDIS in operation have become S-101 compatible. This situation is expected near the end of the decade, but will be continuously monitored to enable a decision to be made by the responsible IMO body.
21. As a consequence, new ECDIS systems to be brought into the market at the time when S-101 ENC coverage starts (2024) will have to be capable to process both transfer standard formats: S-57 ENCs and S-101 ENCs.
22. Safety of navigation will be maintained by cartographic content of both S-57 and S-101 standards. From the user’s perspective, presentation of cartographic and functional features to meet the IMO mandated content in a mixed environment of S-57 ENCs and S-101 ENCs in one ECDIS device will be seamless and presented under the identical presentation regime for charted features and navigational objects.

It should also be noted that other pressures on content of standards (e.g. introduction of S-mode) and timescales may impact what is practically achievable within the confines of standards not wholly under the control of IHO.

There are gaps in the current IHO standards baseline around definition of some of the items in the list given (most sections in (4) require a configurable catalogue of some kind, some of these are mature already (e.g. feature catalogues and portrayal catalogues), and some require resource to baseline within the standards (e.g. Alarms/Indications).

IHO Test datasets

The current structure of the IHO standards base includes the presence of IHO S-64 tests which are used (and referenced from IEC61174). IHO S-64 contains the following logical groupings of tests:

1. Chart Loading and Updating (Section 2) – covers both encrypted and non-encrypted data
2. Chart Display (Section 3)
3. Functions associated with Chart display (Section 4)
4. Detection and Notification of: (Section 5,6 and 7)
 - a. Navigational Hazards
 - b. Areas for which Special conditions exist
 - c. The safety contour

This structure can be preserved as it mirrors the IMO ECDIS/ENC concept functionally and provides a good framework for performing such tests. It is proposed that S-64 will be enhanced with S-100-based test datasets and scripts to match the provisions in the revised IEC61174. IEC61174 will be revised to link to the newer parts of the IHO standards base and form the testing specification for the S-100 ECDIS.

In line with the dual-fuel concept, elements of S-64 relating to S-57 will be preserved and placed alongside new sections dealing with S-100 testing

S-64 revision scope

The revision to S-64 can therefore be split into three distinct activities:

1. Revisions to existing tests to ensure S-57 is adequately tested for as under the current revision of the standard in respect of the operation of a Dual Fuel ECDIS (as this is more fully defined) – the approach to be taken would be to isolate and preserve S-57 functionality within the ECDIS during the transition period proposed..
2. Revisions to the existing test sections adding tests for the equivalent S-100 functionality (primarily S-101 but also including tests from the other primary navigation groups of product specifications). These would include, for example, Display Base/Standard/All, Equivalent Alarm/Indication functionality, marginalia and mariner's objects, load/unload/delete and manual/auto update as per the existing sections of the IMO PS.
3. New tests for:
 - a. Functionality not already contained within existing ECDIS, and which test new elements specifically introduced with S-100
 - b. ECDIS compatibility with data not predefined in the list 3(b) of the previous. This will test the ECDIS ability to self-configure to datasets previously undefined.
 - c. Co-existence with S-57 datasets in all applicable areas of ECDIS functionality as defined by the IMO PS.

For example, revisions of existing tests should include:

- S-101 symbology (and feature catalogue revisions)
- Chart 1
- Different layers and their characteristics (including backwards compatibility with existing S-52 symbology)
- Alarm/indications, hazard detection and safety contour generation exhaustive testing
- Route checking as per the existing test dataset structure

The idea of the S-64 revision would be to partition data tests into S-57 and S-100 based testing and to ensure that when S-57 is finally retired the removal of its tests are straightforward.

New tests required should cover the emerging feature set defined of S-100 including:

1. Introduction of new catalogues and data to the system including their load, installation, upgrade, rollback and tests of features introduced (and removed) by them. These catalogues should contain (at least) detailed tests for core navigation data (S-101 + others) and test upgrades of:
 - a. Feature
 - b. Portrayal
 - c. Pick report / interrogation
 - d. Alarm/indication and SC generation
 - e. Context Parameters and Viewing Group definitions
 - f. Interoperability
2. Additional tests similar to (1) with arbitrary (dummy) product specifications designed specifically for test scenarios. This should be a simple (but functionally complete) product specification introduced to the EUT and tested against the list above. Testing should include the ability of these product specifications to be used to enhance the ENC data on the system
3. Dual-fuel operation – ensuring IMO PS functions behave as they should when S-57 and S-100 data co-exist on the system and a user is using both for navigation.

Gaps in current IHO baseline.

Some gaps exist in the current IHO standards baseline. They are noted as follows:

1. Statement of alarm/indication relevant features and their operation within S-100 product specifications in relation to the IMO Performance Standard. Although some work has been done in this area it is not yet complete and requires full specification and baselining in the next version of S-100. This should define which features (and bindings) define alarm/indication behaviour specifically in relation to the IMO regime – this should also be compatible with, and work in harmony with, the interoperability specification, S-98.
2. S-52 portrayal contains some elements which are not wholly chart-based but which are tested by IEC61174 and specified within S-52 as well as S-64 and tested explicitly for under S-64. It is planned to centralise some of these elements within the S-100 standards for ECDIS. Some examples are:
 - a. Chart 1
 - b. North arrow, Scale bar and other marginalia
 - c. HO/Non-HO data boundaries and No Data available
 - d. the interaction with S-62 for data producer codes denoting non-official data
3. Specification of Pick Report functionality on a per-product specification basis. This should cover the data exposed to interrogation and enough information (e.g. field names, types, content specification) to allow dynamic creation of the interrogation interface for each product specification.
4. Specification of context parameters and viewing group names on a per product specification basis. Should provide dynamic specification of options and layer names/groups for each product specification.
5. Revision status of data within a service to support inspection regimes. Currently this is specified within IHO S-63 but is not part of the new S-100 Part 15.

Conclusions

The preparation of a new edition of S-64 and the tests to support it can commence while the items in the previous section are being defined. The work in updating S-64 can be done in several phases.

1. Creation of a new edition accommodating a defined dual-fuel ECDIS concept (i.e. allowing both S-57 and S-100 based data)
2. Baselining and checking the existing test dataset is comprehensive for S-57 elements of the future ECDIS.
3. Enhancements to the existing test dataset in respect of S-100 data.
 - a. Update of existing tests to put S-100 equivalents alongside the existing test datasets. This would be the set of tests defined in the earlier section covering install, load, display, interrogation and use of product specifications in addition to S-101.
 - b. Specification of new tests for functionality introduced specifically by S-100 (and as exercised by the core product specifications).
 - c. Tests for install/load and use of arbitrary product specifications – requires definition of dummy product specifications.
4. Addition of tests covering co-existence of S-57 and S-100 data together.
5. Integration of tests supporting new functionality and pre-existing tests into a coherent test suite for new ECDIS.
6. As gaps are filled in new ECDIS functionality tests can be updated. This would cover the gaps identified in the previous section, i.e. as pick report and alarm/indication catalogues are defined, tests for their certification can be introduced into the test suite.

Action required of S-100WG5

The S-100WG is invited to:

- Note the contents of this paper as a summary of the more detailed report submitted to this meeting
- Note the proposed summary of S-100 ECDIS functionality within this paper
- Endorse the proposed structure of test enhancements to a revised IHO S-64
- Endorse the proposed content of the revision to S-64 summarised in this paper and contained in the full report submitted to the WG
- Note the current gaps in the IHO standards baseline and the need to further (and more fully) define the Dual-Fuel ECDIS in current IHO proposals to the broader IMO community.