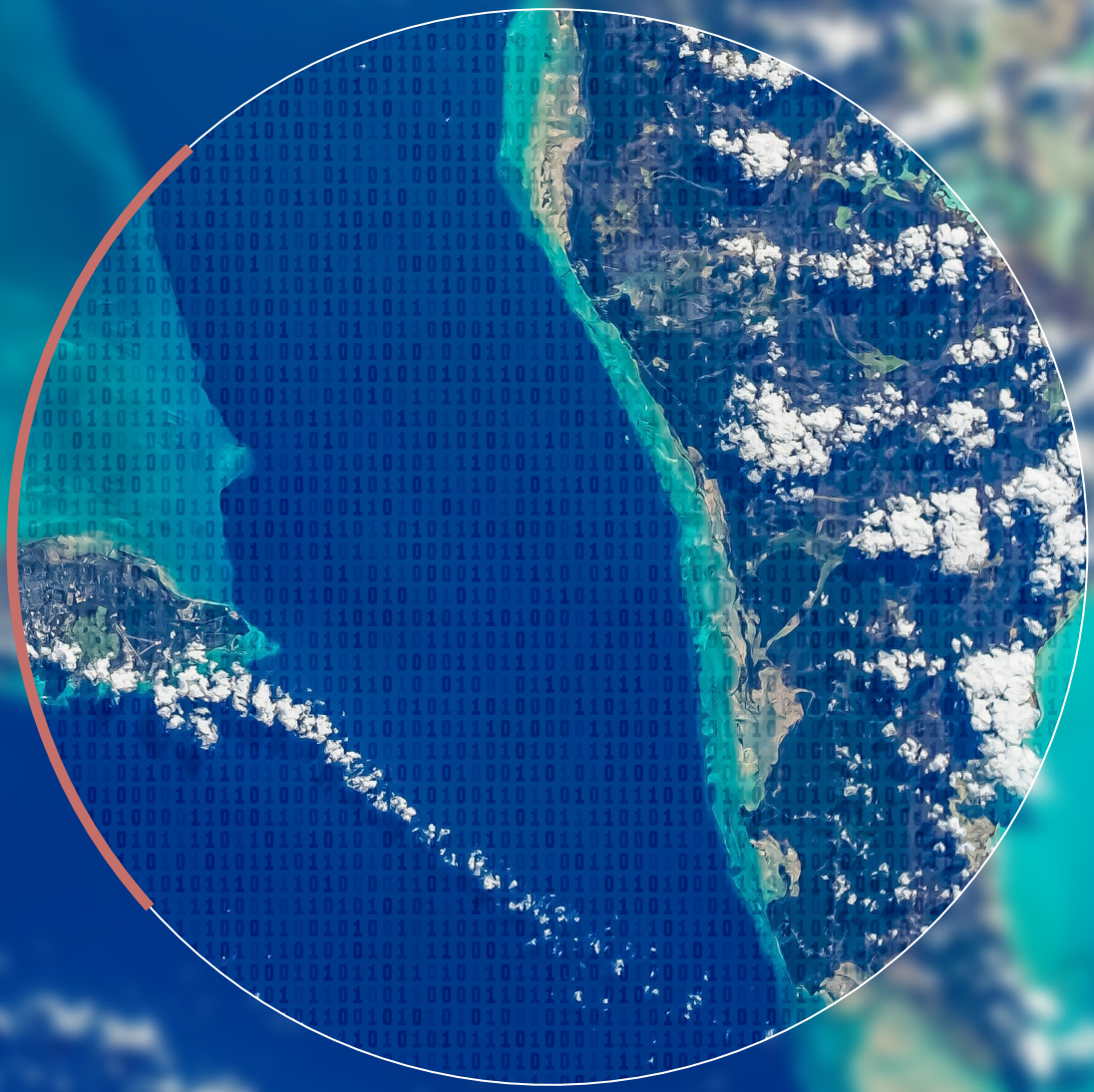
The VisionMaster S-100 ECDIS

A step change for marine navigation



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the navigation experts

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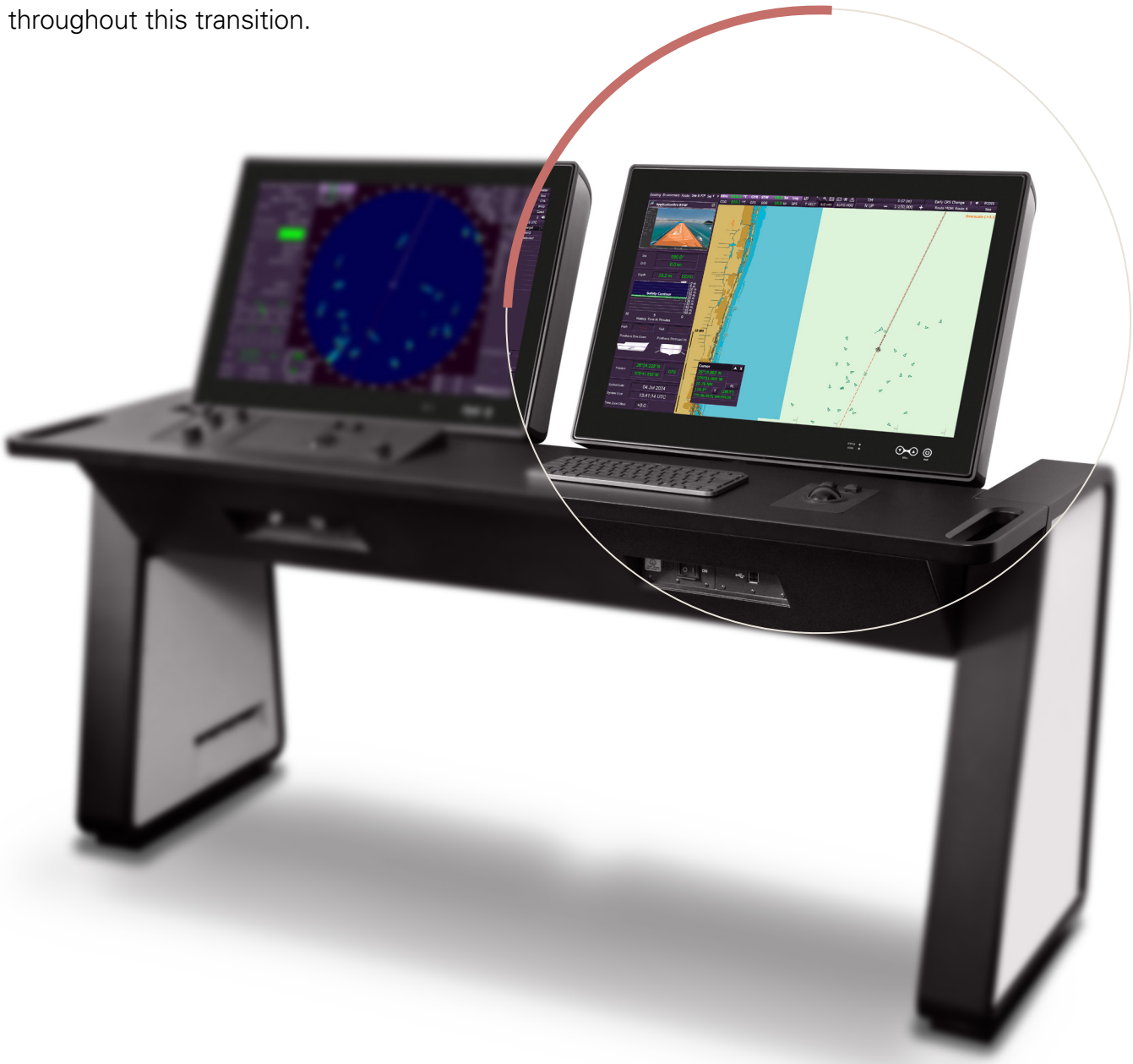
Introduction

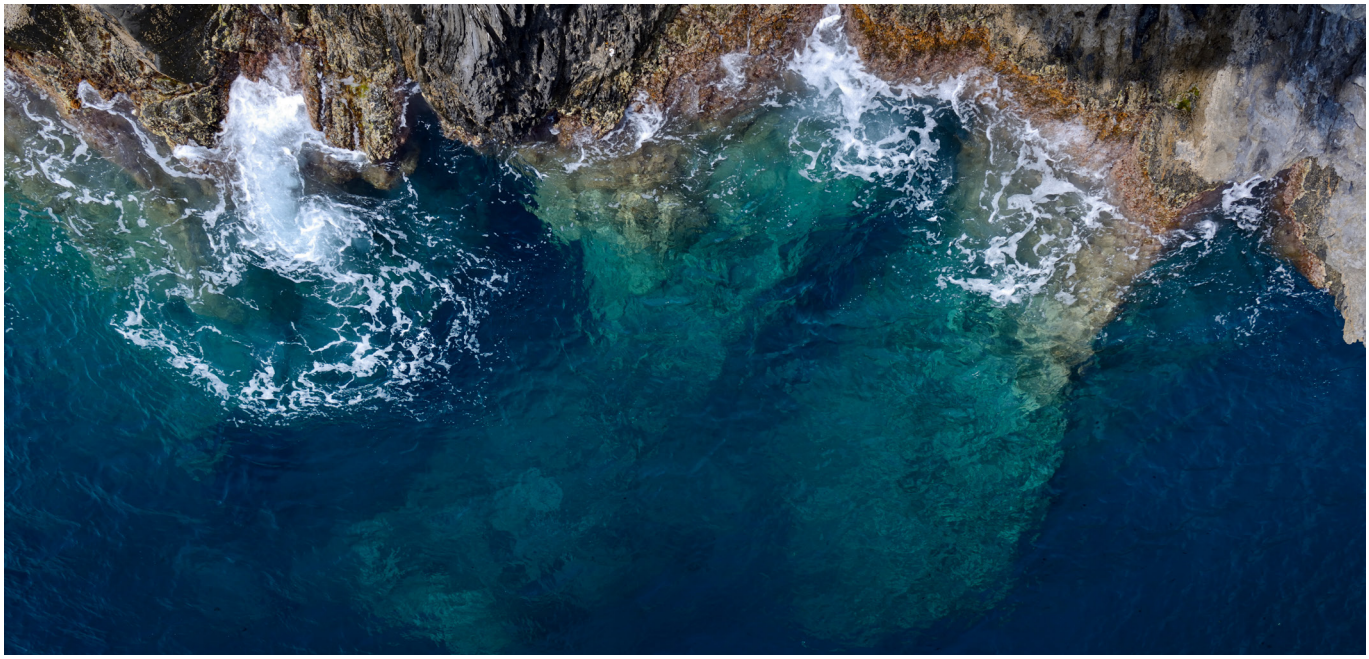
The new S-100 standards represent a step change for marine navigation. Published by the International Hydrographic Organization (IHO), they promise improvements to safety and operational efficiency, and a reduction in mariner workload.

In this whitepaper, we explore how the forthcoming VisionMaster S-100 ECDIS takes advantage of these changes and consider the impact on in-service ECDIS, new equipment procurement and crew training.

Sperry Marine, a key player in maritime technology, is well positioned to be a guide throughout this transition.

> S-100 is a step change for marine navigation.





The rationale for S-100

The IHO is an intergovernmental organisation that works to ensure all the world's seas, oceans and navigable waters are surveyed and charted. In support of these goals, the IHO publishes the standards used by hydrographic offices to compile electronic navigational charts (ENCs) as well as the standards used by Electronic Chart Display and Information System (ECDIS) to read and display the ENCs.

The key standards currently used by ECDIS are S-52, S-57 and S-63. Put simply, S-52 defines how the data is presented by the ECDIS, while S-57 defines how the hydrographic data is formatted and S-63 provides cyber security, ensuring the data that is presented can be trusted.

When these standards were introduced in the 1990s, they were transformational. They enabled machine-readable charts that could be interrogated by a computer to portray the hydrographic data, develop a safety contour automatically and alert the mariner to charted dangers. The standards were an essential part of the transition from the paper chart to the electronic chart. Recognising the impact on crew training, the IMO model course on 'Operational use of ECDIS' (1.27) was developed to ensure mariners could use the technology safely and effectively.

By 2009, the IHO was reporting 77% global ENC coverage for coastal charts and 84% ENC coverage for the top 800 ports. Since 2018, all passenger ships of 500 GT and upwards, as well as cargo ships and tankers of 3,000 GT, have been required to carry ECDIS.

However, decades since their original development, the standards are showing their age. They are difficult to extend – to add new types of charted objects, for example – and when the IHO needed to address anomalies by updating its 'Presentation Library' standard to 'PresLib 4', it was found that all in-service ECDIS software needed to be updated – a significant undertaking.

> The S-100 framework supports digitalisation in the maritime industry well into the future

Standard	Title
IHO S-52	Specifications for Chart Content and Display Aspects of ECDIS
IHO S-57	IHO Transfer Standard for Digital Hydrographic Data
IHO S-63	IHO Transfer Standard for Digital Hydrographic Data

In the meantime, improvements to bandwidth, reliability and cost-effectiveness of communication technology, including the emergence of low-Earth orbit satellites, made it increasingly practical to deliver additional information to the vessel with high speed and low latency. This opens the possibility to provide new layers of data, some potentially in near-real time, to support voyage planning and route monitoring. Such layers of digital data are also well suited to autonomous navigation.

Building on the themes of 'digitalisation' and 'decarbonisation' in the marine world, these drivers supported the view that a new approach was needed and led to the IHO developing the S-100 range of standards.

S-100 explained

S-100 is the IHO's new Universal Hydrographic Data Model – a standards framework introduced to free the production, distribution, portrayal and management of hydrographic information from the constraints of the existing standards and to ensure the industry can sustain growth into the future.

S-100 is based on **contemporary geospatial standards** (ISO 19100). It allows **multiple layers of navigational data** to be presented simultaneously on a single display using interoperability rules to ensure that the layers interact with each other in way that supports the mariner's tasks without introducing screen clutter. Each layer is defined by its own product specification, with S-101 being the product specification for ENCs.

The S-100 framework is **extensible**, allowing new data products to be added as the need arises. It also promises improved **maintainability** as some ECDIS characteristics are defined in feature and portrayal catalogues that form part of the exchange set, reducing the need for an ECDIS software update when certain revisions to standards are made. Finally, S-100 is **secure**, employing AES-128 data encryption of the entire exchange set.

S-100 capabilities will be rolled-out over several phases

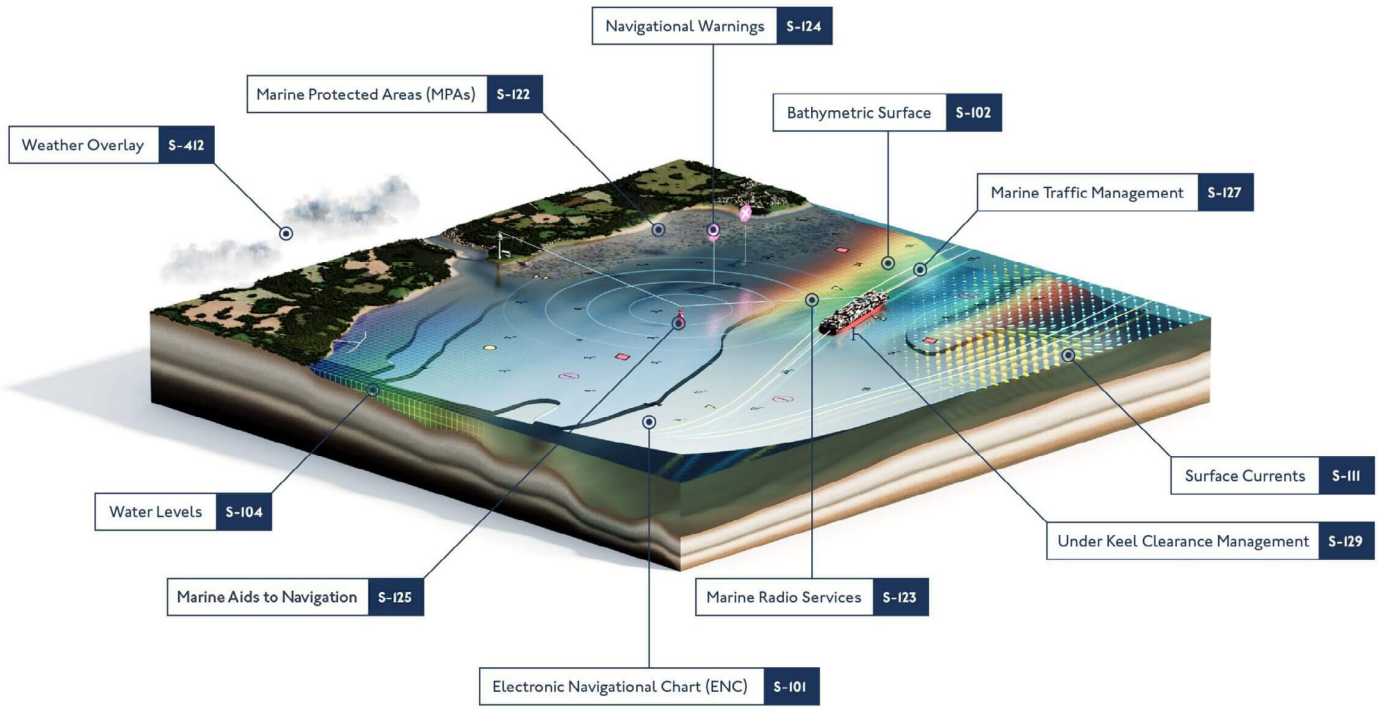
The product specifications supported by S-100 ECDIS are introduced in phases, with the initial S-100 ECDIS supporting all Phase 1 products:

- S-101 Electronic Navigational Chart (ENC)
- S-102 Bathymetric Surface
- S-104 Water Level Information for Surface Navigation
- S-111 Surface Currents
- S-124 Navigational Warnings
- S-129 Under Keel Clearance Management

The IHO is developing the following Phase 2 product specifications:

- S-122 Marine Protected Areas
- S-123 Marine Radio Services
- S-125 Marine Aids to Navigation
- S-127 Marine Traffic Management
- S-131 Marine Harbour Infrastructure
- S-411 Ice Information
- S-412 Weather and Wave Hazards

The introduction date of the Phase 2 product specifications is still to be determined by the IHO and may require a software update to the ECDIS. Additional S-100 products are expected to be introduced after Phase 2.



Credit: UKHO

S-100 ECDIS introduction dates

IMO is introducing the S-100 ECDIS through a revision to its ECDIS performance standards. The revised performance standards are in Resolution MSC.530(106)/Rev.1. The key IMO in-force dates for new installations are:

Date	Event
1 Jan 2026	New ECDIS installations **may** voluntarily conform to MSC.530(106)/Rev.1
1 Jan 2029	New ECDIS installations **must** conform to MSC.530(106)/Rev.1

In practice, type approval of the S-100 ECDIS requires the ECDIS test standard IEC 61174 Edition 5. This is being developed by the International Electrotechnical Commission (IEC) and, at the time of writing, is forecast to be published in July 2027. Manufacturers will then complete product development and type approve the S-100 ECDIS.

The European Union (EU) Marine Equipment Directive (MED), used for type approval in EU countries, can only incorporate test standards once they are published. The MED is updated annually, typically in July or August each year, with the content frozen several months prior to publication. This implies that EU type approval of the S-100 ECDIS to MSC.530(106)/Rev.1 and IEC 61174 Edition 5 is unlikely to be available to any manufacturer before mid-2028.

> From 1 January 2029, all new ECDIS installations need to support S-100

Impact on in-service ECDIS

IMO has not set a date for when existing ECDIS installations need to be updated. For the time being, in-service ECDIS can continue to be used, do not need to use S-100 standards and do not need to be updated to comply with Resolution MSC.530(106)/Rev.1.

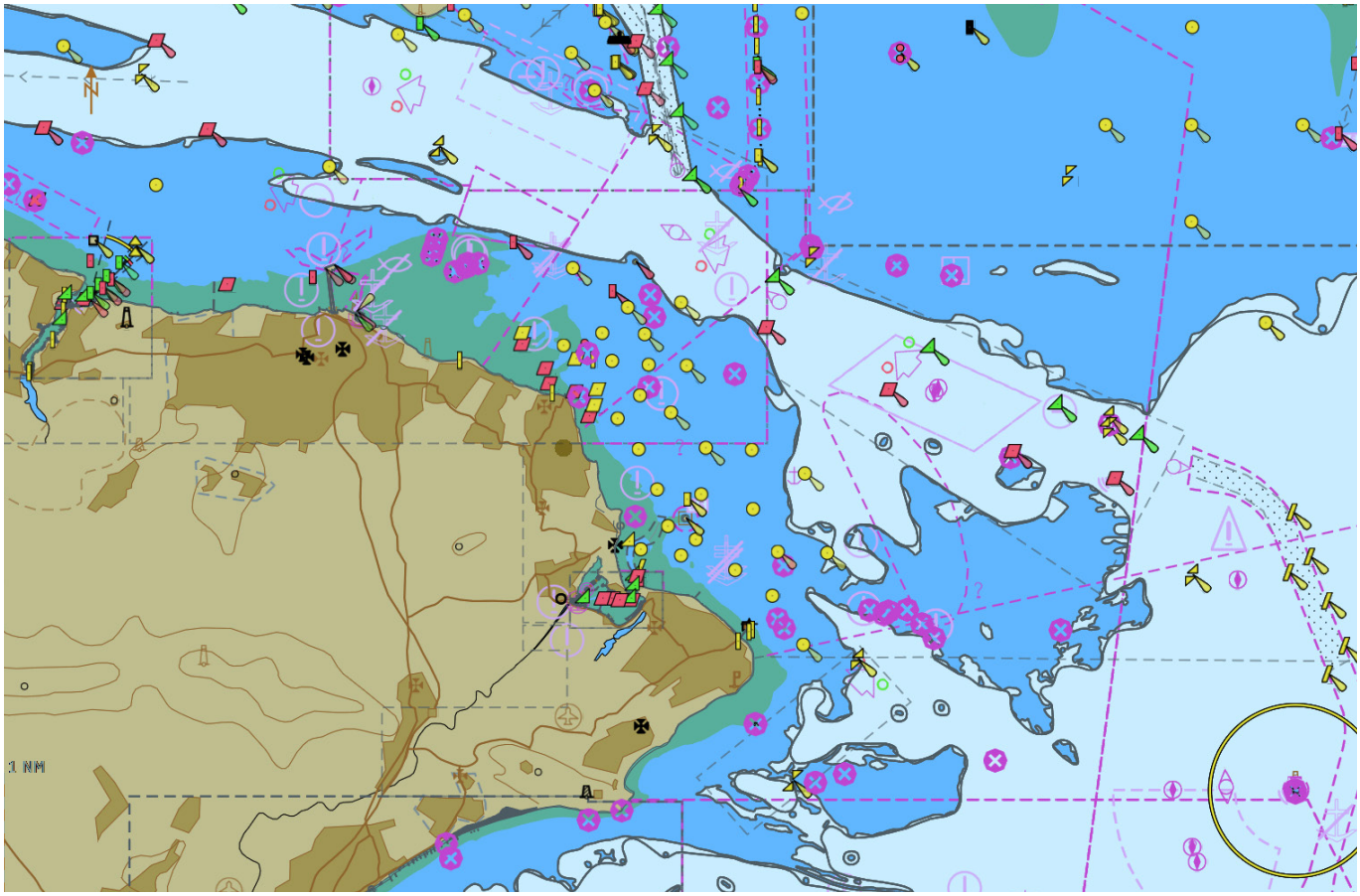
Hydrographic offices will continue to publish S-57 ENCs for use on existing ECDIS for the foreseeable future. However, at some stage, the 'sun-setting' of S-57 can be anticipated, after which only S-101 ENCs will meet the chart carriage requirement. However, the date for this 'sun-setting' is not yet known.

Introducing the dual-fuel mode

The S-100 ECDIS is 'dual fuel' – meaning it supports ENCs in both S-101 and S-57 formats. This is essential because hydrographic offices need time to build up the same global coverage of S-101 ENCs that is provided by S-57 today.

During that period, owners of vessels with an S-100 ECDIS will be able to choose whether to use S-101 or S-57 ENCs, according to availability for specific sea area and mariner preference. Typically, S-101 ENCs will be used where such data is available, and S-57 ENCs will be used for the other sea areas, with both working seamlessly together on a single display.

Since the full benefits of S-100 are only available in conjunction with an S-101 base layer, there should be a clear incentive to choose S-101 ENCs for sea areas where they are available.



VisionMaster showing S-101 ENC

S-101: ENCs improved

Mariners who are used to S-57 ENCs will be immediately familiar with S-101 ENCs because the same chart symbols are used. However, the new format provides hydrographers with greater control of how the data is portrayed, delivering small but important improvements to the mariner, such as:

- Better orientation of text with respect to the charted object – reducing overlapping text on the ENC
- Enhanced encoding of sectored lights – allowing sector information to be provided in a single 'pick report'
- Improved control of the portrayal of complex light sectors and flares – reducing overlaps in sea areas where many sectored lights exist
- A new emergency wreck-marking buoy type
- Colour-filled symbols for buoys and beacons – more visually intuitive for mariners, augmenting the current simplified symbols
- The ability to include multiple additional languages in the S-101 ENC – extending the cur-rent S-57 provision of English and one additional national language, and allowing mariners to select their preferred language from a wider range
- Support for a broader range of character sets – aligning with The United Nations Declaration on the Rights of Indigenous Peoples

The availability of these improvements in any particular chart is dependent on the issuing hydro-graphic office making use of the new capabilities available in S-101.

> S-101 ENCs will immediately be familiar to the mariner

Official IHO chart symbols including the new Emergency Wreck Marking Buoy – far left

Additional S-100 layers

Greater benefits of S-100 are derived when an S-101 ENC is combined with other layers. The display of additional layers is always at the mariner's discretion: the mariner is in control of which layers are presented and can tailor the layers on display at any time to suit the sea area and task at hand.

S-102: Bathymetric Surface

A well-documented limitation of S-57 ENCs is that the depth contours available in the chart are limited in number. The result is that when a mariner selects a safety contour depth, a contour of that depth may not be available in the ENC, and the ECDIS automatically selects the next-deepest available contour. This contour can be substantially deeper than the depth requested by the mariner and so can result in a significantly reduced navigable sea area. Workarounds exist but have considerable drawbacks, while the introduction of high-definition ENCs has only partially ad-dressed this issue.

The Enhanced Safety Contour available in the S-100 ECDIS uses S-102 Bathymetric Surface data to address the issue. S-102 is a rectangular grid of depths that provides a greater granularity than that available in an S-57 ENC. When the mariner selects the 'Enhanced Safety Contour', the ECDIS creates a safety contour at the requested depth by automatically combining S-101 and S-102 data. The data products S-101 and S-102 are designed to be 'interoperable', avoiding screen clutter.

Studies are showing that an 'Enhanced Safety Contour' can open up new navigable areas, resulting in safer or more efficient routes. The Enhanced Safety Contour is only available in areas where there is both S-101 and S-102 coverage.

S-102 introduces the Enhanced Safety Contour

S-104: Water Level Information

Existing standards prevent the ECDIS from adjusting charted depths to take account of astronomical and meteorological effects on water level. As a result, mariners must make their own calculations and adjustments.

Water Level Adjustment using S-104 'Water Level Information for Surface Navigation' addresses the issue by automatically adjusting the charted depths on the mariner's behalf. S-104 is a rectangular gridded data set containing water depths that can be combined with S-101 and S-102 data to provide an adjusted depth. The data products S-101, S-102 and S-104 are designed to be interoperable, avoiding screen clutter.

S-104 data can include data for a range of time periods. To support both route planning and route monitoring, the mariner will be able to select S-104 data sets relating to:

- The current time
- A time specified by the mariner
- The predicted time of transit in each area along the route if the route includes a schedule

It is anticipated that this automatic adjustment will improve safety and reduce the mariner's work-load, while economic benefits may arise if it becomes apparent that sea areas previously considered too shallow are, in fact, navigable. Water Level Adjustment is only available in areas where there is S-101, S-102 and S-104 coverage.

S-104 introduces Water Level Adjustment

S-111: Surface Current

S-111 'Surface Current' datasets contain the magnitude and direction of the surface current over time in a grid format or a series of discrete points.

S-111 data is overlaid on an S-101 ENC using arrows whose orientation, colour and size indicate the velocity of the water.

Knowledge of surface currents is an important part of modern-day navigation. As well as supporting more fuel-efficient route planning and better decision making during route monitoring, using the same S-111 data on both an ECDIS and a pilot's portable pilot unit can enhance safety on the bridge by ensuring both mariner and pilot have a common operating picture.

> S-111 offers a common operating picture

S-124: Navigational Warnings

The S-100 ECDIS will be able to accept S-124 'Navigational Warnings'. The machine-readable data allows a geographic overlay on the chart that can be queried by the mariner so that the full message can be read. S-124 Navigational Warnings are not currently part of the Global Maritime Distress and Safety System and IMO is exploring the best way to deliver the data set to vessels.

At the time of writing, several administrations and the IMO are exploring the best way to deliver this data set to vessels.

> S-124 provides an automated overlay of Navigational Warnings

S-129: Under Keel Clearance Management

The S-100 ECDIS will be able to accept S-129 'Under Keel Clearance Management' data to support safe passage through shallow waters. Where administrations or shore authorities provide such services, a route plan can be shared by the vessel together with the schedule and ship particulars such as draught information. The shore-based system uses this data to calculate an overlay that depicts safe and unsafe waters for the given route on the ECDIS.

The S-129 layer is designed to be non-intrusive, providing visual information only, without accompanying alerts.

Again, at the time of writing, several administrations and the IMO are exploring the best way to de-liver this data set to vessels.

> S-129 Under Keel Clearance Management services will have regional availability

S-100 Data Distribution

IMO's Guidance for an IP-based S-100 Distribution Framework is in development and is expected to be adopted in 2026. The guidelines will set expectations around the technical delivery of S-100 data to the vessel and ECDIS.

The current distribution mechanism that uses value-added resellers and distributors is expected to remain in place and be used for core data products such as S-101 ENCs, S-102 and S-104 data. However, for data products that are considered to require near 'real-time' delivery, such as S-124 'Navigational Warnings' and S-129 'Under Keel Clearance Management', new secure communication technologies tailored for the maritime environment are proposed.

The technologies are SECOM (defined in IEC 63173-1) and the Maritime Connectivity Platform (MCP). These technologies ensure that delivery from maritime service providers is secure and authenticated.

> IMO is developing an S-100 distribution framework

The VisionMaster S-100 ECDIS

Improvements available in the VisionMaster S-100 ECDIS extend beyond those provided by the S-100 data products. Some of the more significant changes are described below.

Enhanced Danger Indications

VisionMaster already provides a graphical indication of charted dangers along the planned route when route planning and along own ship's current path when route monitoring.

VisionMaster S-100 ECDIS will additionally provide a graphical indication of dangers along current and next legs while route monitoring. This ensures the mariner has advanced warning of dangers along the planned route before a turn and even when the vessel has deviated from the route plan.

Mariner-Defined Categories for Danger Checking

VisionMaster checks all dangers (Isolated Dangers, Aids to Navigation, Prohibited Areas and Areas where Special Conditions Exist) along the planned route and along own ship's current path. While this behaviour is dictated by the current IMO performance standard, mariner feedback suggests that, in certain circumstances, it can result in unnecessary alerts during route monitoring.

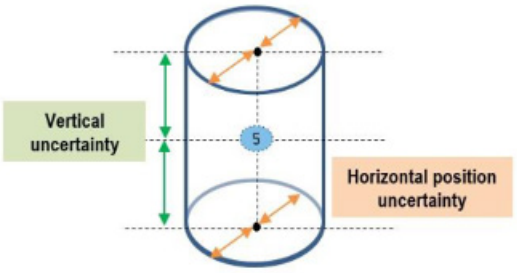
VisionMaster S-100 ECDIS addresses this by providing the mariner with control over the categories of objects to be checked. This should avoid superfluous alerts while ensuring the mariner maintains awareness of important dangers. A permanent indication is provided so that the mariner is always aware when categories are deselected.

> The VisionMaster S-100 ECDIS offers benefits wider than S-100

Automated Horizontal Accuracy Checks

Mariners are required to take the horizontal accuracy of the charted objects into consideration when checking for charted dangers during route planning. The CATZOC (category of zone of confidence) parameter encodes horizontal accuracy for a particular sea area, but this currently needs to be manually applied by the mariner.

VisionMaster S-100 ECDIS reduces the mariner's workload and improves safety by allowing the CATZOC horizontal accuracy to be automatically applied when checking for dangers both when route planning and when route monitoring.

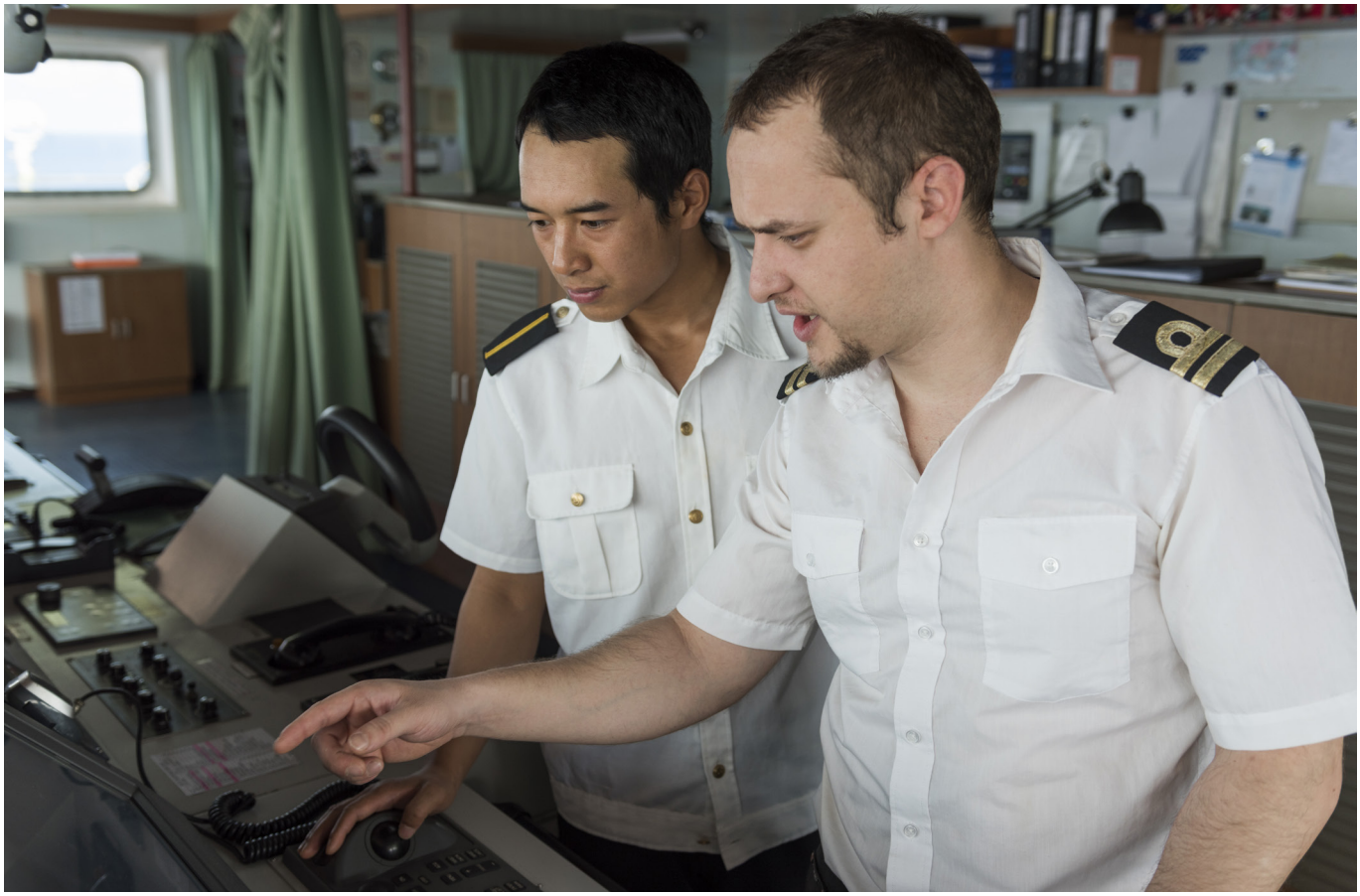


Zone of confidence cylinder (Credit: IHO)

Safety Contour Alarm Selection

The safety contour alarm may be unnecessary in certain situations such as when approaching a berth. Although the alarm is mandated by current standards, mariners report this it can result in distraction due to unnecessary audible alerts.

VisionMaster S-100 ECDIS provides the mariner with control of when the safety contour alarm is raised. A permanent indication ensures that the mariner is always aware when the alarm is deselected.



S-100: An Emerging Landscape

Some aspects of the S-100 ECDIS are still being developed by the IMO, IHO, IEC and other bodies. Important workstreams that are under way include:

- Finalisation of IHO standards capable of supporting type approval of the initial S-100 ECDIS – expected to be approved by the IHO in 2026
- IMO guidance for an IP-based S-100 Distribution Framework (described above) – planned for adoption by IMO in 2026
- Development of the associated ECDIS test standard (IEC 61174) – forecast publication by the IEC in July 2027

It is only when this body of work is completed, and the hydrographic offices and data distributors have determined the exact products that they will make available to the market, that the precise capabilities of the S-100 ECDIS will be fully known. As a result, the content in this white paper may be superseded and augmented as the work matures.

Important work to finalise S-100 is under way

Mariner Training

Ships' masters and deck officers are required to complete generic ECDIS training and an ECDIS familiarisation programme so that they fully understand the use of ECDIS for passage planning and navigation. Ship safety management systems are required to include familiarisation with the ECDIS equipment fitted.

The S-100 ECDIS introduces new concepts together with new ECDIS behaviour; Water Level Adjustment and the Enhanced Safety Contour are two key examples. Use of the additional data layers needs to be considered carefully, and cyber security implications need to be assessed. It is clear that training programmes must be adjusted accordingly.

Mariners need training to use the S-100 ECDIS

IMO is responding to the adoption of the new ECDIS performance standards by revising the IMO model course on 'Operational use of ECDIS' (1.27). Sperry Marine will ensure new familiarisation material is made available for the VisionMaster S-100 ECDIS. Vessel operators need to consider how to update safety management systems to fully address the new ECDIS.

Appendix

S-100 Phase 1 product specifications

Standard	Title
S-101 Electronic Navigational Chart	Provides the base navigational chart layer for the ECDIS in a similar way to S-57.
S-102 Bathymetric Surface	Bathymetric data in a rectangular grid that can be used to develop a more finely graduated safety contour than that available in the baseline S-101 data. The vision is that it will become easier for the mariner to select the contour that is best aligned to the navigational need, reducing workload and improving safety. S-102 data will be available in selected sea areas.
S-104 Water Level Information for Surface Navigation	A gridded layer of water level information, including tidal information, that can be used to adjust the safety contour from the chart datum level. In the future, real-time water level information may become available. The vision is to make it easier for the mariner to take water level into account, reducing workload and improving safety. Taken together, S-102 and S-104 could provide economic benefits by allowing vessels to sail in are-as previously considered inaccessible. S-104 data will be available in selected sea areas.
S-111 Surface Currents	A graphical overlay of surface currents on the ENC
S-124 Navigational Warnings	A graphical overlay on the ENC of Navigational Warnings (urgent information relevant to safe navigation) made available from shore-based authorities. For the foreseeable future, S-124 is not part of the GMDSS.
S-129 Under Keel Clearance Management	A ship and voyage specific graphical overlay of non-navigable areas that has been provided by an Under Keel Clearance Management service provider. It allows a vessel to determine the time periods when there are suitable tidal conditions for it to transit a UKCM Operational Area, thus supporting safety and environmental protection, particularly in sensitive shallow waters.

The navigation experts

Sperry Marine delivers industry-leading, maritime navigation solutions that ensure your vessel operations are safer, more efficient and sustainable.

These integrate systems, digital services and support to suit all your different vessel and operating requirements. Our extensive portfolio includes radars, ECDIS, compasses, steering systems, autopilots, speed logs and Integrated Bridge Systems. And secure, connected services that support your digital transformation.

Our global service network covers all the major shipping areas in Europe, Asia and the Americas. This comprises our own team of over 150 experts and 100 authorised service partners, who are all certified to ensure they install and support our products to the highest standards on a 24/365 consistent global basis.

Based on over 150 years' experience, Sperry Marine's navigation solutions are trusted on thousands of vessels at sea by the world's leading shipping companies.

Global Service and Support

Sperry Marine provides service and support on a 24/365 basis at every major port worldwide, at anchor, offshore and at sea. All Marine Service Engineers are all certified to ensure they install, maintain and repair our products to the industry's highest standards on a consistent global basis. Please see **www.sperrymarine.com/service** for full details of all our service locations.

Find out more

Please visit **www.sperrymarine.com** for more information on Sperry Marine's complete range of solutions.
If you would like a quotation, please email **sales@sperrymarine.com.**

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