**S-98**



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**Annex C**

**Harmonised User Experience for ECDIS and INS**

**Edition 1.3.4 – July 2024**

|  |
| --- |
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**Further Changes identified after publication (before completion of adjudication review)**

1. Changes to must – interoperabilityIdentifier
2. Add new section for loading/rendering display from 101PT. This should also include any relevant text from the S-101PS which is generic enough to be used in other product specs (particularly S-401) and which may not have been seen by OEMs.
3. Must clarify for overscale + new diagram for loading/rendering and link to section.
4. Clarify further wording on the versioning following TSM words.(and including the table from TSM). This has been agreed by S101PT as well.
5. Where is vertical datum information found (clarify header vs features). And do we need to clarify horizontal datum too?.
6. Update Information to be added.with both models.
7. Data quality is a date-dependent feature, note for info, when the data quality portrayal is received and added into PS
8. Datums in ECDIS legend need to be clarified.
9. Languages, need to clarify how the ECDIS uses the context parameter holding the language list.
10. The other components of S-98
11. Chart 1, there is only one method for its display
12. All the optimumDisplayScale changes.
13. HTML/XML is out for now, NIPWG can bring it back in if it can be specified properly.
14. Find better location for language on shared edges (in opposite directions)
15. IMO requirements for data quality to be takein into account. Applies to Charts, also S-102 and S-104.
16. There is no interoperability catalogue yet.
17. Add standardised GML description (as per TSM paper)
18. Better language on support files.

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**Document History**

Changes to this Specification are coordinated by the IHO S-100 Working Group. New editions will be made available via the IHO website. Maintenance of the Specification shall conform to IHO Resolution 2/2007 (as amended).

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| --- | --- | --- | --- |
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| 0.0.2 | 01 Nov 2021 | J.Powell | Numerous revisions to take into account the S-98 Correspondence Group adjudication work. |
| 1.0.0 | May 2022 | S-100WG | Submission to HSSC14 for approval. |
| 1.0.0 | May 2022 | HSSC | Initial published version for evaluation and testing. |
| 1.1.0 | August 2023 |  | Added MSC.530(106) in place of MSC.232(82) and updated text accordingly (“SENC” to “System Database”- various clauses); updated tidal stream panel presentation (C-15.4); fixed heading 1 and heading 2 styles; added new clause listing allowed support file formats for ECDIS and elaborated rules for additional information in text (C-11.5); struck alternate labels in Tables C-2 and C-3; |
| 1.2.0 | February 2024 |  | Collection of issues identified by subgroup and external stakeholder. |
| 1.3.0 | May 2024 |  | Incorporating stakeholder inputs, GitHub discussions and TSM 2024 outputs. |
| 1.3.4 | July 2024 |  | Version after review meetings |
|  |  |  |  |
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# Introduction

This Annex contains guidance for the implementation of harmonised portrayal and other user interaction functionalities for S-101 Electronic Navigational Chart (ENC) and other S-100 based data products in an Electronic Chart Display and Information System (ECDIS). It describes how S-100 products are to be used and displayed simultaneously on the navigation screen. It does not address the portrayal processes or architectures, which are addressed in S-100 Part 9. It is based on the general principles described in S-100 Part 16A, and the requirements for ECDIS specified in the relevant International Maritime Organization (IMO), International Hydrographic Organization (IHO), and International Electrotechnical Commission (IEC) standards.

This Annex is the successor to the IHO S-52 Standard for chart content and display in ECDIS. It contains material from S-52 that has been updated for S-100, but does not include symbol specifications (the S-52 “presentation library”) or portrayal rules because symbols and portrayal rules are now defined in the IHO GI Registry and portrayal catalogues for individual product specifications. This document focuses on the principles for portraying S-101 ENC and S-100 based data on ECDIS. The principles described herein are intended to be compatible with the corresponding requirements for ECDIS portrayal of S-57 ENCs.

This Annex does not revoke nor does it supersede S-52 in its applicability to the use of S-57 information on ECDIS. It assumes ECDIS will support both S-52/S-57 and S-101 ENCs for the foreseeable future. Such systems should continue to follow the S-52/S-57 standards for S-57 information.

ECDIS presentation and user interactions are determined by the following standards:

* IMO standards control presentation, performance, and user experience. They include standards and guidelines for display and user interaction, including alerts.
* IHO standards provide the framework for data content, primarily in S-100. S-100 also provides an abstract specification for visual interoperability; for ECDIS, details about interoperability are specified in S-98.
* IEC standards describe methods and required results for equipment and system testing.
* Data product specifications describe the content, data formats, symbols, portrayal rules, packaging, and delivery, of individual data products. For ECDIS, the basic data product is S-101 (Electronic Navigational Charts). Other products describe additional information relevant to navigation, for example, bathymetry, currents, water levels, regulated areas, services and weather.

The standards that are current at the time of writing of this Annex are listed in the References section. More detailed information about the various standards is provided in S-100 Part 16A.

Application developers should obtain an up-to-date set of applicable standards and specifications from the relevant organisations. Developers must conform to the mandatory requirements of the particular standards which apply to an application or system. In case of a conflict between this Annex and a mandatory requirement in an applicable standard, the requirement in the standard supersedes the guidance in this Annex.

The specifications in this Annex also apply to navigation displays in an Integrated Navigation System (INS) which fulfil the role of an ECDIS.

Users of this document should refer to IEC publications when dealing with implementation testing.

# References

## Normative references

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IEC 60945 *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*, International Electrotechnical Commission (IEC), Fourth Edition, 2002.

IEC 61174 *Maritime navigation and radiocommunication equipment and systems – Electronic chart display and information system (ECDIS) – Operational and performance requirements, methods of testing and required test results*, International Electrotechnical Commission (IEC),IEC 62288 *Maritime navigation and radiocommunication equipment and systems – Presentation of navigation-related information on shipborne navigational displays – General requirements, methods of testing and required test results*, International Electrotechnical Commission (IEC), Edition 3.0, 2021.

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MSC.252(83) *Performance Standards for Integrated Navigation Systems (INS)*, IMO Resolution 252(83), 2007.

MSC.302(87) *Adoption of Performance Standards for Bridge Alert Management*, IMO Resolution 302(87), 2010.

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MSC.1593 *Interim Guidelines for the Harmonized Display of Navigation Information Received via Communication Equipment*, IMO MSC.1/Circ.1593, 2018.

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S-100 *Universal Hydrographic Data Model*, IHO Publication S-100, Edition 5.2.0 ( 2024).

SN.1/Circ.243/Rev. 2 *Guidelines for the Presentation of Navigational-Related Symbols, Terms and Abbreviations*, IMO SN.1/Circ.243/Rev.2, 2019.

## Informative references

ISO 19117 *Geographic Information – Portrayal*, ISO Standard 19117 Edition 2, 2012.

S-4 *Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO*, IHO Publication S-4, Edition 4.8.0, October 2018. (Parts B and C in particular.)

S-52 *Specifications for Chart Content and Display Aspects of ECDIS*, IHO Publication S-52, Edition 6.1.1, June 2015.

# Abbreviations and Notation

## Abbreviations

AIS Automatic Identification System

ARPA Automatic Radar Plotting Aid

CRS Coordinate Reference System

CSS Cascading Style Sheets

EBL Electronic Bearing Line

ECDIS Electronic Chart Display and Information System

ECS Electronic Chart System

ENC Electronic Navigational Chart

ENDS Electronic Navigational Data Service

ENP Electronic Nautical Publication

GML Geographic Markup Language

HO Hydrographic Office

INS Integrated Navigation System

IEC International Electrotechnical Commission

IHO International Hydrographic Organization

IMO International Maritime Organization

SD System Database

SVG Scalable Vector Graphics

VRM Variable Range Marker

XML EXtensible Markup Language

XSLT EXtensible Stylesheet Language Transformations

## Notation

The following notation is used throughout the document to describe various portrayal aspects.

(Name of feature or information type)

Features and information types are referenced by their names in camel-case or space-separated names in initial capitals (“LandArea” or “Land Area”).

(Name of attribute)

Attributes are referenced by their names in camel-case with initial letters in lower case, or space-separated names in all lower case (“visuallyConspicuous” or “visually conspicuous”).

**(Portrayal register item)**

Items from the IHO portrayal registry are referenced by their registered name and item type (“line style SCLBDY51”). The portrayal registry is a component of the IHO Geospatial Information Registry (<https://registry.iho.int>).

## Normative vs Informative within this document.

This document uses the word “must” to describe mandatory functionality for S-100 ECDIS. In many cases within this document S-100 ECDIS behaviour is described which is mandatory, but which is illustrated using examples which are contained in operational/run-time S-100 elements such as feature or portrayal catalogues.

In many cases this document describes functionality which is mandatory for the S-100 ECDIS, but its implementation is fulfilled by the implementation of S-100 itself. For example there is a requirement to implement standard display layers Base, Standard and Other. This document does not define those layers, they are implemented by the S-101 portrayal catalogue, thus the requirement is fulfilled by implementation of S-100 Part 9 and the ability to read and correctly portray ENC data. Where this is the case functionality will be described using examples drawn from individual product speciications but the S-100 product specification catalogues remain normative. Where this is the case the product specification feature and portrayal catalogues remain the normative reference and this document will describe the required functionality as normative.

Where these differences exist, they are noted in section heading footnotes. Where this document refers to mandatory functionality defined elsewhere it

# *Background - System Concepts and Limitations*

## The concepts of ENC, ENDS and System Database

The Electronic Navigational Data Service and System Database concepts include multiple products for use in navigation systems. They were introduced in IMO MSC 530(106) and update the previous concept of SENC defined in IMO MSC.232(82).

IMO MSC.530(106) defines Electronic Navigational Chart (ENC), Electronic Navigational Data Service (ENDS), and System Database as follows:

3.2 Electronic Navigational Chart (ENC) means the database, standardized as to content, structure and format, issued for use with ECDIS by or on the authority of a Government, authorized hydrographic office or other relevant government institution, and conforming to IHO standards. The ENC contains all the nautical chart information necessary for safe navigation.

3.3 Electronic Navigational Data Service (ENDS) means a special-purpose database, compiled from nautical chart and nautical publication data, standardized as to content, structure and format, issued for use with ECDIS by or on the authority of a Government, authorized hydrographic office or other relevant government institution, and conforming to IHO standards; and, which is designed to meet the requirement of marine navigation and the nautical chart and nautical publications carriage requirements in SOLAS regulations V/19 and V/27. The navigational base layer of ENDS is the electronic navigational chart.

3.4 System Database means a database, in the manufacturer’s internal ECDIS format, resulting from the lossless transformation of the ENDS contents and its updates. It is this database that is accessed by ECDIS for the display generation and other navigational functions, and is equivalent to up-to-date ENDS.

The System Database is compiled from one or more S-100-based products and/or S-57 based products.

## ECDIS concept, limitations, and challenges

IMO MSC 530(106) also defines Electronic Chart Display and Information System (ECDIS):

3.1 Electronic Chart Display and Information System (ECDIS) means a navigation information system which with adequate backup arrangements can be accepted as complying with the up-to-date nautical chart and nautical publications required by SOLAS regulations V/19 and V/27, by displaying selected information from a system database with positional information from navigation sensors to assist the mariner in route planning and route monitoring and, if required, display additional navigation-related information.

The following list explains more of the ECDIS concept in detail and provides information about certain limitations.

1. ENC is an integral part of ECDIS and therefore is defined as the base layer for the portrayal harmonisation framework. Additional layers are classified as two main types, additional information to that of the ENC or enhanced information to that of the ENC. Additional information is information that is not contained in the ENC, while enhanced information are layers that contain improved, detailed or higher resolution information than the ENC.
2. ECDIS, used together with official data, [is] accepted as complying with the up-to-date nautical chart and nautical publications carriage requirement required by regulation V/19 and V/17 of the 1974 SOLAS Convention amended in 2009. Electronic chart systems not meeting these ECDIS specifications of IHO and IMO, or ECDIS using non-official data, are known as ECS (Electronic Chart Systems).
3. Chart information may be used in conjunction with a radar overlay on ECDIS. Integration of tracked radar targets provided for collision avoidance radar (ARPA) or targets reported by AIS (Automatic Identification System) can be integrated into the ECDIS display, as well as other navigational information which may be added to the ECDIS display. With the advent of S-100, additional types of data may also be occasionally added to the ECDIS display, especially high-density bathymetry, surface current and water levels data or predictions, maritime safety information (MSI), and under keel clearance area data.
4. Colours and symbols defined in the S-101 portrayal catalogue are conceptually based on the symbology of conventional paper charts. However, due to the special conditions of the ECDIS chart display as a computer-generated image, the ECDIS presentation of ENC data may differ from the appearance of a conventional paper chart, especially when simplified portrayal mode is used. There may be considerable differences in symbology in shape, colour and size, and in the placement of text in particular.
5. ECDIS combines chart and real-time navigational positioning information. Modern navigation systems (i.e. GNSS) may offer a more accurate positioning than was available to position some of the surveys from which the digital chart data ENC was derived. Further, other products may not be encoded to the same accuracy or precision as ENC data or ship’s positioning, therefore there is a potentially greater reliance on metadata covering data quality and precision in a digital navigation context
6. The display categories specified in the IMO Performance Standards and the IHO priorities of the various types of chart information (alerts, updates, mariner's and non-HO chart data, etc.) are applied to features by the display plane and drawing order assignments in individual portrayal catalogues. The drawing order may be modified if interoperability is activated.
7. For definition of ‘single operator action’ and ‘simple operator action’, see IMO MSC.252(83).
8. In the initial period of S-100 roll-out, S-100 compatible ECDIS will be “dual-fuel” in that they will have both S-57 and S-101 ENCs (see:C-18). It is possible that there will be situations where the navigation screen will display both S-57 and S-101 ENCs. The user experience aspects of such situations are discussed in Clause C-18.

The versatility of ECDIS poses several challenges for ECDIS display design. These challenges are discussed below.

The diversity of information displayed on an ECDIS may include:

* physical chart information, for example, coastline, depth contours, buoys;
* traffic routeing; specified areas; cautions; etc.;
* supplementary HO information from light list, etc.;
* mariner's notes; additional local chart information; manufacturer's information;
* chartwork such as planned route; electronic bearing lines and range rings; etc.;
* own ship's position and velocity vector; ship's head and rate of turn; past track;
* fix accuracy, or position check from secondary positioning system;
* possibly, ship handling options, based on ship’s characteristics, alphanumeric navigation information (ship’s latitude, longitude, heading, course, etc.);
* information from radar and other sensors;
* information from AIS;
* navigational indications and alerts generated by ECDIS;
* possibly, telemetered information from shore authorities (traffic, real-time tides etc.);
* possibly, ice information;
* reminders (for example, time to contact pilot station);
* possibly, messages from other displays.

The flexibility of portrayal may include:

* displaying/removing various types of chart and non-chart information,
* selecting standard chart display or a thinned out display, and either paper chart symbols or simplified symbols,
* using cursor interrogation for further detail,
* overlaying/removing radar video or radar target information (in order to: confirm ship’s positioning; aid radar interpretation; show the entire navigation situation on one screen),
* overlaying/removing various other sensor information, or information telemetered from shore,
* changing the scale or orientation of the display,
* selecting true motion or relative motion,
* changing screen layout with windowed displays, text information in the margins, etc.,
* possibility of pull-down menus and other operator interaction devices being alongside the operational navigation display and so interacting with it,
* giving navigation and chart warnings such as “too close approach to safety contour”; “about to enter prohibited area”; “overscale display”; “more detailed (larger scale) data available”; etc.,
* possibly, a diagrammatic representation of a computer evaluation of grounding danger,
* possibly, a diagrammatic representation of the immediate vicinity of the ship to aid in close quarters manoeuvring,

### Depth Related Functionality

S-100 ECDIS allows Water Levels to be automatically adjusted using an interoperable combination of S-101, S-102 and S-104 data, both for monitoring and planning purposes. This is described fully in appendix C-2**.**

## Integrated Navigation System (INS) concept, limitations and challenges

The concept of an Integrated Navigation System (INS) is outlined in the IMO Performance Standards MSC 252(83). INS workstations have multifunctional displays providing at least route monitoring and collision avoidance functions, and may provide manual or automatic navigation control functions. In addition to these functions, an INS generally also provide route planning, navigation control data and status, and alert management functions. INS integrate sources, data, and displays into one navigation system. An INS may consist of multiple task stations.

Since the concept of ECDIS is included in the INS concept, the principle described in clause C-6.1.1 of having ENC as the base layer applies – but in the context of an INS it applies to components playing the role of an ECDIS. Components playing other roles will generally use ENC or similar data, but this may depend on function and task.

The considerations related to portrayal that are in addition to the requirements already embedded in the INS standards are outlined below:

1. An INS may substitute under some carriage requirements for certain navigational equipment. The INS is required to fulfil the requirements for the systems it replaces. For example, an INS component used for the tasks of route monitoring and route planning must meet the requirements for an ECDIS, which are described in IMO MSC 530(106). This means that the portrayal and user interaction considerations for an ECDIS described in C-4.2 apply to the workstation playing the role of an ECDIS.
2. All tasks of an INS should use the same electronic chart data and other S-100 navigational databases such as routes, maps, tide information. If ENCs are available, they should be used as a common data source for INS.

IMO Performance Standards (MSC.252(83)) state that for each task it is used for, the INS should fulfil the relevant modules of the performance standards for standalone equipment for the task. An INS display being used for route monitoring will be subject to the ECDIS performance standards, and therefore the relevant INS display will have largely the same limitations and challenges described in clause C-4.2. The potential availability of other workstations in an INS allows manufacturers somewhat more flexibility in designing solutions, but this is limited by human factors constraints related to compatibility and divided attention.

Given the complexity of the issues and the necessity for compatibility, this document does not distinguish between INS and ECDIS displays for the purpose of harmonised portrayal. If the data products are shown on the same screen, the same rules apply for INS and ECDIS displays, and the treatment should be the same for INS as for ECDIS. If the data products are on different INS screens, the treatment should be compatible in the sense of the guidelines in IMO Circ.1609.

# User Interface Design

## General principles

The guidelines in IMO MSC.1/Circ.1609 (Guidelines for the Standardization of User Interface Design for Navigational Equipment) apply to the design of user interfaces for navigation systems such as ECDIS and INS. The general principles are described in MSC.1/Circ.1609 and are summarised in S-100 Part 16A.

## ~~User interface elements Deleted~~

# Data Layers

## Data products and information layers

### Basic product specifications and layers

Navigation displays such as the ECDIS main screen **must** be able to display at least the following data products:

* S-101 ENC data as the base layer, alongside S-57 ENC data
* S-102 Bathymetric Surface;
* S-104 Water Level information for Surface Navigation;
* S-111 Surface Currents;
* S-124 Navigational Warnings;
* S-129 Underkeel Clearance;
* S-421 Route Plan.
* S-128 Catalogue of Nautical Products

### Other data products

The intention is that in future editions of this document, when operational product specifications are published by IHO, navigation displays such as the ECDIS main screen will allow the mariner to toggle the display of the following data products

* S-122 Marine Protected Areas;
* S-123 Marine Radio Services;
* S-125 Marine Aids to Navigation
* S-126 Physical Environment
* S-127 Marine Traffic Management;
* S-131 Marine Harbour Infrastructure.
* WMO S-411 Dynamic Ice Information
* WMO S-412- Marine Weather Warnings

## Mitigation of data overload

Each additional data layer multiplies clutter and the potential for hiding critical information. General user interface principles as well as IMO guidance (MSC.191(79), MSC.1/Circ1609) recommend avoiding cluttering screens with too much information. The standardised mechanism for reducing clutter is the S-98 interoperability mechanism, described in outlined in C-8

Detection of and response to possible data overload should be guided by the role a particular system is playing at the moment (e.g., a display being used for planning may be able to treat potential overloading in a laxer manner than navigation displays being used for route monitoring and collision avoidance). See clause C-8.3.10 for user interface recommendations relating to possible data overload.

# Portrayal Process, Catalogue Elements, and Alerting

This section provides a brief, informative summary of the S-100 portrayal process, the main elements of Portrayal Catalogues, and the alert model. More details about the process and definitions of Portrayal Catalogue elements and the alerting model are available in S-100 Parts 9 and 9a.

Later sections of the present document describe how the portrayal elements should be used in an ECDIS implementation.

## Overview of the portrayal process

The system has feature data within its internal database that needs to be portrayed. The System Portrayal Engine transforms the feature data into drawing instructions according to the portrayal rules defined in the Portrayal Catalogue. The drawing instructions are intermediate data used by the rendering engine to produce the portrayal output. Drawing instructions include such things as references to symbol definitions, priority and filtering information. The symbol definitions contain the details of all graphical elements used for the portrayal. The drawing instructions are processed by the rendering engine to produce the final display according to the output device.

S-100 describes two different portrayal mechanisms, one based on XSLT templates and the other on a scripting architecture based on Lua. The basic portrayal process is the same for both, and is described in S-100 Part 9; variations to the process and input/output that are required for Lua Portrayal Catalogues are described in Part 9a.

When interoperability is activated and there is an interoperable product loaded to the display, either feature data or drawing instructions (depending on the implementation architecture) are further filtered and/or have their priorities adjusted as specified in the interoperability catalogue. Interoperability processing is described in S-100 Part 16 and S-98.

In the absence of interoperability, portrayal is as described in S-100 Part 9. When interoperability is activated the portrayal is modified as specified by the Interoperability Catalogue. Interoperability processing is described in S-100 Part 16 and S-98.

## Elements of portrayal catalogues

Much of the content of this section is included for information as it is described definitively in S-100 Part 9 and Part 9a already.

### Pixmaps

Pixmaps can be used for defining pattern fills for areas that are not sufficiently described to be symbolised, or for which no symbol exists in the IHO Geospatial Information (GI) Registry.

### Colour coding scheme

The Portrayal Catalogue uses a colour scheme, which classifies colours by their usage. Each colour usage is represented by a five-letter colour token. Each colour token corresponds to a colour definition given in CIE and/or sRGB coordinates in one of a set of colours; each set is intended for a different bridge lighting condition. Each such set of colours is referred to as a “palette” and is generally identified by a descriptive name, such as “Day-Bright”, “Dusk” and “Night”. A particular colour token is often assigned different CIE/sRGB coordinates in different palettes (especially day/night/dusk palettes).

A “colour profile”, as the term is used in S-100, is a collection of different palettes within a single XML file. An ECDIS makes palettes for day, night, and dusk conditions available on the system (MSC 530(106) / A10.4.

Symbols, fill styles and line styles refer to the colour tables by using the standardized colour tokens as part of the symbol definition.

### Symbols

The Portrayal Catalogue provides a set of symbols. The symbols for point features are generally based on the traditional paper chart symbols and, in addition a set of more compact, but more visible, 'simplified' buoy and beacon symbols are provided for use under difficult viewing conditions.

### Area fills

The Portrayal Catalogue offers various ways to fill areas. They can be filled with an opaque colour; with a colour shown with some transparency; or with a pattern of symbols (fill pattern) or with a centred symbol. Fill patterns and centred symbols are introduced as a solution for the symbolization of areas in special situations. A fill pattern showing arrows does not have a certain position on the chart like the paper chart arrow symbol. It shows up as long as any part of the traffic separation lane can be seen on the screen. A centred symbol moves to the centre of the part of the area that remains in the display window. Fill patterns or centred area symbols may be used to symbolize the case when the entire display window lies within an area.

The Portrayal Catalogue provides two options for area boundaries, referred to as “plain” and “symbolised”.

Centred symbols are used with symbolized boundaries to symbolize the case when the entire display window lies within an area.

Area boundaries should not be visible on the edge of the display window when the display window is enclosed by an area. However, if the boundary is actually on the edge of the display window, it should be visible.

In the context of S-100 area fills effect surface geometry portrayal.

### Line styles

The Portrayal Catalogue uses two types of line styles: simple line styles and complex line styles. Simple line styles are solid, dashed or dotted lines with varying colour and thickness (width or stroke width). Complex (or “composite”) line styles are composed of repeating line patterns.

Simple line styles are generally described by continuity, width, and colour. The full specification of a simple line style may also include other elements such as dash interval, cap and join types (see S-100 clauses 9-12.4 and 9a-11.2.2.3), defaults for which may be set in the Portrayal Catalogue. Complex line styles consist of additional elements, described in S-100 9-12.4 and 9a-11.2.2.3.

Complex linestyles may be one-sided (symbols, text, etc., which are part of the line extend to only one side of the line) or two-sided (symbols, text, etc. extend on both sides of the line).

In the context of S-100 line styles affect curve geometry portrayal.

**[INSERT image and guidance on portrayal of shared edges]**

### Portrayal of Shared Edges.

Shared edges portrayed with dash patterns may be presented incorrectly to the mariner when the ECDIS draws the edge in both directions. This issue can occur along the shared edges of features which abut, such as restricted areas or anchorages where adjacent edges are drawn in opposite directions.

Rendering the dash pattern in both directions can alter the pattern from what is intended, and in some cases may result in a solid line.

In the figure below, note the edges under the green highlight:

|  |  |
| --- | --- |
| Incorrect presentation | Correct presentation |

This issue can also affect complex line styles, for example:

|  |  |
| --- | --- |
| Incorrect presentation | Correct presentation. |

### Text

S-101 and other Product Specifications may utilize a cartographic feature called **TextPlacement** that is used in association with a feature to optimise placement of labels (usually, either feature name or light characteristic description string).

There are three types of text instructions possible in portrayal catalogues:

* Text relative to a point;
* Text that will be drawn along a line; and
* Text placed relative to an area uses a local coordinate reference system. Note that this can cause the text to be drawn at multiple locations.

However, explicit cartographic placement along curves or relative to area/local CRS cannot be explicitly encoded in S-101 datasets, though it can be encoded in portrayal rules in a Portrayal Catalogue (S-100 Part 9a, clause 9a-11.2).

### Style sheets

Cascading Style Sheets (CSS) files are used to provide different sets of stroke and fill style instructions to be applied to symbols. This mechanism allows changing colours and line weights used in the symbols by swapping CSS files according to the desired colour scheme.

In principle, any style attribute can be set in a CSS file, but the CSS files in IHO Portrayal Catalogues will affect only a limited set of style attributes, namely, stroke and fill colours, line cap and join styles. Note also that the style precedence rules will affect whether the style attribute in a CSS file will actually be applied to a displayed element.

### Display planes

Display planes are used to split the output of the portrayal functions into mutually exclusive lists. An example of this is the separation of chart information drawn under a radar image and chart information drawn over a radar image.

### Display priorities

Display priorities control the order in which the output of the portrayal functions is processed by the rendering engine. Priorities with smaller numerical values will be processed first.

The display priority is a value between '00' and '99' (see Table C-9), where '99' identifies the highest priority. The display priority applies irrespective of whether a feature is a point, curve or surface. If the display priority is equal among features, curve features have to be drawn on top of surface features whereas point features are drawn on top of both. If the display priority is still equal among features of the same type of geometry (curve, surface or point) the given sequence in the data structure of the System Database, or some other neutral criterion, should be used for a decision as to which feature is drawn on top.

Display priorities are also called “drawing priorities” in S-100 Parts 9 and 9a.

### Viewing groups

The viewing group controls the content of the display. It provides an on/off switch in the Portrayal Catalogue for any drawing instruction assigned to the corresponding viewing group.

### Viewing group layers

A viewing group layer defines a collection of viewing groups whose visibility can be simultaneously toggled on/off by an application.

### Display modes

A display mode defines a collection of viewing group layers which can be simultaneously toggled on/off by an application.

### Foundation mode

The foundation mode defines a collection of viewing groups that forms the foundation of the portrayal and cannot be removed from the display. The content of these viewing groups should comply with Display Base rules in IMO MSC.530(106) Appendix 2.

### Rules

A portrayal rule is a set of machine processable statements that describes the transformation of feature data into drawing instructions.

### Context

The context is a set of parameters passed into portrayal processing at the top level. Context parameters are accessible only in processing rules in the same portrayal catalogue, but can be accessed by any of the rules in that portrayal catalogue. These parameters can be used to provide contextual information to the execution of transformation rules in portrayal processing. Examples are settings of depth values for the safety depth, shallow and deep contours.

### Validity times

Drawing instructions can be designated as being valid only during a specified interval, which may be open-ended at either beginning or end, or a single time point (with beginning and end the same). Intervals may be specified in terms of date, time (of day), or date-time endpoints.

The start and end instants are defined by their date/time component of the smallest granularity. For example, if the end instant is specified a date without a time of day, and the interval is “right-closed”, the end instant is midnight at the end of the specified day (240000 in ISO 8601 terms). This is consistent with the S-100 treatment of *dateStart* and *dateEnd* attributes (see S-100 Part 3 clause 3-8-3 (Interpretation of models of time intervals and period), but note that the open/closed nature of the interval affects the interpretation for Part 9 time intervals — if the same interval is specified as “right-open” the start time point is midnight at the beginning of the specified day (000000 in ISO 8601 terms).

## Alerts

The Alerts Catalogue is a component of the Portrayal Catalogue; it describes each alert event along with its associated message(s) and highlighting rules.

The alerting model allows product developers to associate alerts with features (optionally satisfying specified conditions on attribute values) by encoding rules in the Portrayal Catalogue.

Alerts are associated with drawing instructions output by the portrayal, and are triggered when the vessel route (either actual track, during route monitoring, or planned, during route planning) intersects the geometry (which may be restricted or augmented) of a feature. The events are alerts, warnings, cautions, or indications as described in IMO MSC.252(83).

# Interoperability

Ensuring visual interoperability in the presence of simultaneously displayed layers is an important aspect of user interfaces for navigation screens. IHO Publication S-98 (Data Product Interoperability in S-100 Navigation Systems) specifies the structure of an interoperability catalogue to be used for ECDIS and INS. This is currently unpublished by IHO and there is no current requirement for its implementation in ECDIS. Other mechanisms for interoperability between product specifications exist and are defined in this document.

When published by the IHO the Interoperability Catalogue will provide a normative Interoperability Catalogue for S-100 ECDIS and the published IHO product specifications. Therefore, a detailed requirement for its implementation will be contained in a future edition of this document.

S-98 provides, as a minimum for S-100 ECDIS, two levels of interoperability allowing data layers in different products to be interleaved or substituted within the display. It is intended, in a future edition of this document, to also provide user interface requirements for end user control of the visual interoperability.

S-98 itself also permits extensions, substitutes and customizations provided the minimum functions provided by the IHO Catalogue are maintained and interoperability is not degraded (S-98 clauses 12.1.1–12.1.3).

# Display Organisation and Operation

## Display of non-S-100 information

This clause describes the display of information that is not from official S-100-based data products, S-57, radar, or AIS.

### Distinguishing between official data and additional data

IMO Performance Standards (MSC.530(106) section 1.5) states that ECDIS should enable the mariner to execute all route planning, route monitoring, and positioning and sections 3.3-3.4 mean that the ENDS and System Database may contain information from nautical publications as well as ENCs. This specification requires that ECDIS must distinguish between official data and such additional data from users (mariners) and manufacturers. The colour and symbol usage for mariners’ and manufacturers’ data in the IHO GI Registry and the Portrayal Catalogues for S-100 data products are designed to implement this while ensuring the display remains clear and uncluttered.

The official status of data delivered to the ECDIS is defined by the value of a role. This is encoded in the ST field of the X.509 certificate referenced in the mandatory digitial signature accompanying content in the exchange set catalogue. Digital signatures are mandatory for any data imported into the ECDIS, whether official or not. The mandatory fields within every authenticating certificate are defined as:

* **C** (Country) = ISO Country Code of state making request
* **ST** (State or Province) = A code reflecting the role of the signing entity (below)
* **O** (Organisation) = member state organisation name (text) or other organisation name
* **CN** (Common Name) = IHO data producer code integer and alpha code (as part of a colon separated MRN), e.g. **urn:mrn:iho:aa:181**0 or **urn:mrn:iho:GB:540***. For datasets the CN data producer integer and alpha code must match those contained in the* corresponding dataset and its CATALOG.XML entry.

For ECDIS, the ST code holding the role determines whether a dataset or supporting resources is unofficial or official. The following codes are supported by the IHO data protection scheme:

* For S-100 datasets or supporting resources the following roles define official data.
  + **DATA\_PRODUCER** Data Producers - producing data content for live navigation under SOLAS. This data is "official"
  + **DATA\_AGGREGATOR** RENCs/Aggregators - validate, distribute and (sometimes) digitally sign data on behalf of their members. These organisations do not create data content but can sign data as “official”
* S-128 datasets used for ECDIS Update Status reports. These datasets may also be authenticated by:
  + **AGGREGATOR** S-128 producers – aggregate data together for the purposes of running a service for end users. They create and digitally sign S-128 datasets which support their service offering and the production of update status reports
* Catalogues
  + **SCHEME\_ADMINISTRATOR** The Scheme Administrator, the IHO. Only digitally signed catalogues with a certificate authenticated by the scheme administrator may be loaded onto the ECDIS.

ST field values using the role **OTHER\_DATA\_PRODUCER** (or any other value, or those not conforming to the CN MRN format above) represent data or catalogue content which is "unofficial".

### ~~Deleted~~

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### Supplemental display items

The following information must be shown on demand

* Positional data and time;
* Legend (See C-9.1.6);
* Feature description and associated attributes (result of "cursor query") in human readable language; textual information from ENC, for example, dataset name, compilation date, date of issue;
* Record of updates for all data products;
* ECDIS Chart 1, Black adjust symbol for contrast adjustment and colour differentiation diagram (available from IHO S-164);List of categories which are removed from Standard Display;
* Edition and update numbers of S-101 and other Products in use;

### Units

The units listed below must be available, at least, on demand and indicated in the display legend. Equivalent values using other units may also be shown:

Position: Latitude and longitude in degrees, minutes and decimal minutes.

Depth: Metres and decimetres.

Height: Metres.

Distance: Nautical miles and decimal miles; or metres.

Speed: Knots and decimal knots.

### Legend

A standard legend of general information relating to the area displayed, applicable to the position selected by the mariner, must be shown on a graphic or text display. This legend should contain at minimum (and, as applicable):

1. Units for depth;
2. Units for height;
3. Scale of display; in addition overscale indication where appropriate;
4. Data quality indicator;
5. Sounding/vertical datum;
6. Horizontal datum;
7. The value of the safety depth if used;
8. The value of the safety contour selected by the mariner, as well as the value of the safety contour displayed (which may be different from that selected by the mariner);
9. Magnetic variation;
10. Date and number of last update(s) affecting the datasets currently in use;
11. Edition number and date of issue of the datasets;
12. Chart projection.

See clause C-12.10.3 for details about the listed items.

Since attempting to display all the above items for all displayed data products may lead to an unduly large legend, manufacturers may suppress information from data products other than ENCs. If this is done, the suppressed information should be available through simple operator action, such as a temporary expansion of the legend activated by clicking on a target in the legend. (Note that some of the items will be the same for all data products - in particular, units and datums should be the same for all products, or converted to present the same display result, in order to reduce the chances of user error.)

## Priority of information [Informative]

### Priority layers

The IMO Performance Standard divides System Database information into three categories that determine what data is to be on the display: Display Base (always present on the display); Standard Display (the default display); and Other Information (displayed on demand). (MSC.530(106), Appendix 2).

There are 9 basic priority layers for the drawing sequence of the data on the display, ordered from higher to lower priorities in the list below:

1. ECDIS visual alerts/indications (for example caution, overscale);
2. Official-data: Points/Curves and Surfaces + official updates;
3. Notices to Mariners, manual input and Navigational Warnings;
4. Official-caution (ENC and other cautions);
5. Official-colour-fill area data;
6. Official on demand data (for example, water levels, surface currents, underkeel clearance);
7. Radar and AIS information;
8. Mariners data: Points/lines and areas;
9. Mariners colour-fill area data.

This list is not intended to indicate a drawing sequence, but to specify that the information content of category n+1 must not obscure the information content of category n, or any higher-priority category (n-1 etc.).

### Radar priority

Radar priority for a given display plane is described by the *order* attribute within the Portrayal Catalogue.

*RadarOverlay* Portrayal Catalogue context parameters must be updated whenever the radar image is toggled on or off.

When present, the radar image should be written over Portrayal Catalogue display planes with a negative *order* attribute; and below display planes with a positive *order* attribute.

Opaque area fills should generally be assigned to display planes with negative *order* attributes so that they do not obscure the radar image.

Symbolization of curves and points should generally be assigned to display planes with positive *order* attributes so that they are not obscured by the radar image.

In order to meet the requirements of IMO MSC.530(106) section 11.4.17 to adjust the ship’s position, the ECDIS may incorporate the capability of temporarily changing the radar image priority during the adjustment.

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## Displaying ECDIS updates

The strategy for displaying ECDIS updates is derived from the IMO Performance Standard MSC.530(106). The citations below are to sections in that Standard.

MSC.530(106) 4.4, Automatic and semi-automatic updates: These should be displayed in the same manner as ENC information, using standard colours and symbols.

MSC.530(106) 4.5 Manual updates must be distinguished as specified in clause C-14.11

MSC.530(106) 4.7 The mariner must be able to display updates for review as described in clauses C-9.7.1 and C-9.7.2.

### Update Information

The S-101 Feature Catalogue provides encoders with an **Update Information** feature that is used to represent a change to the information shown.

EXAMPLE: The ENC update contains updates to various features that adjoined the feature that was actually updated. In this case, the producer will use an **Update Information** feature to indicate the actual feature that was affected and a brief description of the changes.

*[Describe Update Information intention]*

### Manual updates

The manual updates should be distinguishable from official information and its official updates.

## Display functions

The Portrayal Catalogue defines a number of Independent Mariner Selections and Context Parameters. These must all be implemented and exposed to the end user through the user interface. Many of these may have been implemented for existing (S-57) ECDIS, for example Four Depth Shades, Contour Labels and viewing of Accuracy patterns. Implementation should therefore be harmonised to provide a harmonised user interface.

*[Check there are 164 tests for this clause?]*

# General Rules for Symbols and Text

## Symbol Specifications

All symbols are specified in the Portrayal Catalogue for the respective Product Specifications and are defined according to S-100 Part 9 appendix B.

Some feature classes do not have a symbol (for example, territorial sea). Such "no symbol" features may be picked up by cursor interrogation of the area.

Some features are symbolised differently depending on circumstances (for example the symbol for a contour depends on whether it is the safety contour).

## Reproduction of lines, symbols and text

### Introduction [Informative]

In a navigation system the viewing distance will be about 70 cm for route planning, but experience to date indicates that the viewing distance for important features during route monitoring may be several metres.

Human factors experts recommend that symbols and characters subtend 20 arc minutes at the observer’s eye. (For example, a symbol viewed from 70 cm for route planning should be about 4mm in size, 1.5 times the size of a normal chart symbol. Two times chart size is a good general rule.) Symbols and characters important for route monitoring may have to be significantly bigger.

For clear representation, symbols require a minimum number of screen units (pixels), depending on their complexity. A simple chart symbol of height 4mm should extend at least 13 pixels for a screen that just meets the current minimum standards for chart display size and resolution (clause C-20.1).

The minimum resolution is defined by IEC 61174 and/or IEC 62288.

### Minimum Requirement for size and resolution

Lines, symbols and text should be large enough that they can be easily interpreted at the operational viewing distance. Also, for clear representation, symbols require a minimum number of screen units (pixels), depending on their complexity. The ensuing requirements for size in absolute and pixel terms are described in this clause. [this is PS developer?]

The minimum sizes for all symbols must be as defined in the Portrayal Catalogue.

Enough "picture units" (pixels) must be used to draw small features and symbols clearly and allow viewers to distinguish similar symbols. Symbols must therefore always be drawn with at least the same number of pixels as are required to draw the symbol at the size defined in the Portrayal Catalogue for the minimum resolution and minimum chart display area.

NOTE (informative): This requirement means the minimum height in pixels of a symbol is: (symbol height in mm) divided by the "pixel size" for the minimum size chart display (see clause C-20.1).

The CHKSYM01 symbol may be used for comparison; this symbol should measure 5mm×5mm when displayed at its nominal size (that is, scaled to 100%), within the tolerance specified by the IEC testing standard (recommended tolerance: 1 physical pixel width in each of the X and Y dimensions).

Since the CHKSYM01 symbol is quite small for the purpose of on-site system configuration by ordinary users, manufacturers may use an enlarged version or an equivalent method for that purpose.

[refer to Section 20, and requirements to be satisfied, note that PS developers define symbols]

### ~~Deleted~~

### Zooming

When the display scale is enlarged by zooming in, it must be possible to hold symbol size constant. The same applies to text. Symbol and text size must never be decreased when zooming out.

## ~~Deleted~~

## ~~Deleted (apart from North Arrow para)~~

~~The north arrow must be on the display, as part of the IMO Performance Standards Display Base.~~

## Common text information attributes

Several Product Specifications use similar structures for feature names and information attributes. The following guidelines should be used when this document mentions displaying the “feature name” or “information” attributes.

*[insert overview of how multi-language processing is supposed to work]*

### ~~Deleted~~

### ~~Deleted~~

## ~~Deleted~~

# Text and Graphics

## ~~Deleted~~.

## ~~Deleted~~



## ~~Deleted~~

| **~~Viewing Group Layer~~** | **~~Name of Viewing group layer in the ECDIS~~** | **~~Viewing groups included~~** |
| --- | --- | --- |
| ~~1~~ | ~~Important text~~ | ~~11~~ |
| ~~2~~ | ~~Other Text~~ | ~~20-49, 0-10~~ |
| ~~2.1~~ | ~~Names~~ | ~~21, 26, 29~~ |
| ~~2.2~~ | ~~Light description~~ | ~~23~~ |
| ~~2.3~~ | ~~All other~~ | ~~0-10, 25, 27, 28, 32-49~~ |

~~Table C-18 - Example of subdivision of “Other Text” layer to provide more detailed selections~~

***Nothing in part 9 describes the subgroup mechanism in C-18. Would be useful to describe how to group layers together. This section could usefully provide a concise overview and subgroup advice.***

## Abbreviations [Move to pick report section]

### Text abbreviations [Informative]

The abbreviations in Table C-19 are used on the ECDIS display by the portrayal catalogue.

| **Abbreviations** | |
| --- | --- |
| **Prefixes** | **Suffixes** |
| bn = beacon (INT1)  by = buoy  clr = overhead clearance  clr cl = clearance closed  clr op = clearance open  sf clr = safe clearance  No = number (INT1)  Plt = pilot  Prod = offshore production (INT1)  LtV = light vessel  varn = magnetic variation  ch = communication channel  NMT = not more than “CLEARING BEARING”  NLT = not less than “CLEARING BEARING” | kn = knots (INT1)  deg = degrees |

Table C-19 - Abbreviations and format specifiers used by portrayal catalogue

## ~~Deleted~~



## Support files with Graphical Content

S-101 datasets encode graphical information such as diagrams and photographs in support files using one of the S-100 image formats.

ECDIS manufacturers must provide appropriate solutions that enable pictures to be displayed without affecting the night vision of the user. *The luminance of the displayed image must be in the same band as the current palette in use at the time the image is displayed*.

Manufacturers must be prepared to handle pictures of resolution of at least 800 x 800 pixels.

The availability of additional information in graphical format is indicated by the same symbolisation as other supplementary information.

# Miscellaneous Display Elements

This section describes additional display elements and special symbols and considerations for ENC data, including chart furniture, contours, mariners’ features, IMO-required elements, and presentation of updates.

Cursor pick reports and information displays in off-graphic panels are described in clause C-15.

## Elements related to data and display scales

### ENC scale

~~The~~ *~~minimumDisplayScale~~* ~~and~~ *~~optimumDisplayScale~~* ~~of the ENC is the range of scales at which the ENC was designed to be displayed. It may not be the same as the scale of the source data.~~

The term “scale” is used to describe either:

* Display Scale, or Mariner Selected Viewing Scale (MSVS)
* The scale of the source data used to compile the ENC.
* Data Scale (the values used for the attributes *minimumdisplayScale*, *maximumDisplayScale*, *optimumDisplayScale*. This may not be the same as the scale of the source data used to compile the ENC. These values define the range of scales at which ENC coverage may be displayed.

The values used for the Data Scale attributes *minimumDisplayScale* and *optimumDisplayScale* are fixed, and taken from the table below:

|  |
| --- |
| **Scale** |
| NULL |
| 1:10,000,000 |
| 1:3,500,000 |
| 1:1,500,000 |
| 1:700,000 |
| 1:350,000 |
| 1:180,000 |
| 1:90,000 |
| 1:45,000 |
| 1:22,000 |
| 1:12,000 |
| 1:8,000 |
| 1:4,000 |
| 1:3,000 |
| 1:2,000 |
| 1:1,000 |

***Table 2.5 -*** *minimumDisplayScale* and *optimumDisplayScale* values

### Overscale

Overscale is where the mariner has zoomed larger than the largest *maximumDisplayScale* of the ENC data that is shown in the mariner’s viewing window.

#### Overscale Indication [UNDER DEVELOPMENT]

The overscale indication is intended to remind the mariner that the size of chart errors is magnified when they increase the display scale. A 1 mm error at *maximumDisplayScale* of 1/20,000 becomes a 1.3 mm error at a display scale of 1/15,000 and a 2 mm error at 1/10,000.

The overscale factor **must** be calculated as

[denominator of the *maximumDisplayScale*] / [denominator of the mariners selected viewing scale]

and expressed as, for example "X1.3", or "X2" (using the figures in the example above.)

This **must** be indicated on the same screen as the chart display, and treated as display base. Use colour SCLBR.

This overscale indication is required by IMO Performance Standards (MSC.530(106)) whenever the display scale exceeds the maximum intended viewing scale as indicated by *maximumDisplayScale*.

NOTE If the display is compiled from more than one ENC of the same *maximumDisplayScale*, and if the mariner deliberately chooses to zoom in so that the display scale exceeds the *maximumDisplayScale*, then only the "overscale indication" must be shown. The "overscale pattern" (area fill OVERSC01) must not be shown.

### Scale boundary

This shows where the *optimumDisplayScale* of the ENC data available changes. The ECDIS should warn the mariner of upcoming ENC scale change. Only the major changes in *optimumDisplayScale* resulting from the scale jumping more than three steps in *optimumDisplayScale* should be shown. The steps are given in S-101.

The "chart scale boundaries", where the *optimumDisplayScale* of the data changes, must be symbolised on the ECDIS display by a solid 0.32mm wide line using colour token CHGRD. Alternatively linestyle SCLBDY51 may be used. The display priority is 3; over-radar; standard display; viewing group 21030.

When scale boundaries of smaller scale **Data Coverage** areas overlap larger scale **Data Coverage** areas, that portion of the scale boundary which intersects the larger scale **Data Coverage** area should not be visible.

### Overscale area at scale boundary

ECDIS displays all chart data at the same scale. In order to avoid leaving part of the display blank, the display may be rendered using data from multiple datasets. These datasets may contain **Data Coverage** areas with varying *optimumDisplayScale*.

The area fill OVERSC01 must be used to indicate **Data Coverage** areas displayed X2 or more larger than the *optimumDisplayScale*; provided that the area was displayed automatically by the ECDIS in order to avoid leaving that portion of the display blank.

NOTE: This rule applies only to the automatic overscaling performed by the ECDIS in matching ENCs at different *optimumDisplayScale*. It should not be applied to an overscale display deliberately requested by the mariner, which should trigger the overscale indication required by IMO Performance Standard MSC 530(106) section 6.1.1.

A different overscale situation arises when the ship approaches a scale boundary from a larger to a smaller scale ENC, typically when leaving harbour. In combining data from the large scale and the small scale ENCs to generate a display at the larger scale, the ECDIS will have "grossly enlarged" the small scale data.

In addition to drawing the scale boundaries, the "grossly overscale" part of the display must be identified with area fill OVERSC01, as illustrated in Figure C-1.

In this context, "grossly enlarged" and "grossly overscale" should be taken to mean that the display scale is enlarged/overscale by X2 or more with respect to the *optimumDisplayScale*. For example, at the left edge of Figure C-1 the display scale of 1/12,500 is X4 the *optimumDisplayScale* of 1/50,000, and so the overscale pattern is required.

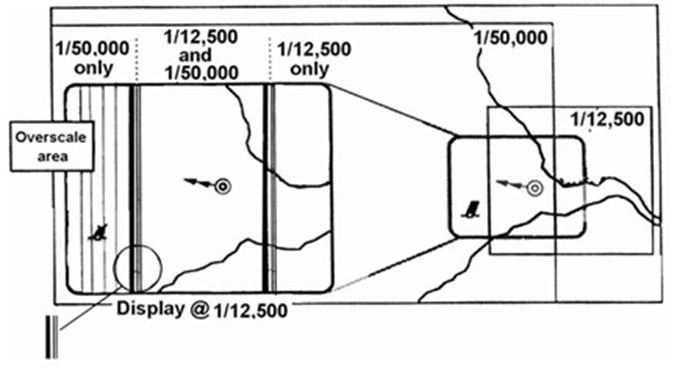


Figure C-1 - Illustration of overscale display

[The right hand side of the Figure shows the ENC layout with the screen window overlaid, and the left hand side is enlarged to show the ECDIS display on that screen.]

Note that in this situation the OVERSC01 area fill should only be shown on the area compiled from the smaller scale ENC. If the area from the larger scale ENC is also overscale, this should be indicated by the "overscale indication". The OVERSC01 area fill should not be shown on the part of the display taken from the larger scale ENC. For example if the optimum display scale of the situation in the data coverage diagram was 1/3,500 the area of optimum display scale 1/12,500 would have an overscale indication of X 3.6 but would have no OVERSC01 area fill.

### Larger scale data available

As the mariner’s display window moves and begins to cover an ENC that is of a larger *optimumDisplayScale*, the ECDIS must indicate that larger scale data will shortly become available, as required by IMO Performance Standards.

## Graphical indexes

### Graphical indexes of ENCs

The system **must** be capable of displaying a graphical index of ENCs~~.~~

All datasets installed on the system must be included in the graphical index.

ENC Discovery metadata from Exchange Catalogue files in Exchange Sets, installed S-128 datasets or compilations derived from such Exchange Catalogue files, may also be used as long as the graphical index distinguishes them from datasets installed on the system.

**[INSERT Coverage Standardisation of GML. Ref: TSM paper]**

**The description of dataset extents in ENC discovery metadata in exchange catalogue files uses a fixed format, described in Appendix XX.**

### Graphical indexes of other S-100 products

The system may implement a capability for displaying graphical indexes of non-ENC data products

If the system displays graphical indexes for different products simultaneously, the indexes should be distinguishable. For example, dataset extent boundaries in the graphical index may be designed so that the dataset boundaries for one product do not hide the dataset extents of another product; or the system may provide a means of emphasizing the extents for a product selected by the mariner.

## Limits of data

### [ENC]

The ECDIS must fill any areas in which there is no installed ENC coverage using area pattern NODATA03, using colour token NODTA. These areas are defined as no data areas.

The***an (the)***must be shown areas in which there arewith s installed *(harmonise with S-52 (“exists”))*

must also [*ref non official data section (next section)*]

### Limit of HO S-101 data and data from non-HO sources [could apply to all products]

The limit of HO S-101 data on the graphical index defines the limit of HO ENC coverage. **[*insert ref to certificate parameters for official/unofficial data***]

~~The limit of HO S-101 data relative to “no data” areas need not be demarcated on the display~~. The appearance of the “No data” colour (colour token NODTA) and NODATA03 area fill (see C-12.3.3) will indicate the end of HO data.

If non-HO chart data is shown on the ECDIS display, its boundary should be demarcated by the line style NONHODAT. Note that the NONHODAT line style is a “one-sided” line and the boundary of the non-HO data must be drawn according to S-101 rules to ensure that the diagonal stroke of the line is on the non-HO data side of the line. The non-HO data boundary indicated by the NONHODAT line style serves to separate ENC data from non-HO chart information.

### Limits of other S-100 product data

To reduce screen clutter, “no data” areas and “non-HO data” boundaries for products other than S-101 and S-57 ENCs should be depicted only when specifically called up by the mariner for a product, and then only if the product is actually displayed on the screen. The (*chosen*) fill patterns and boundaries should indicate the product to which they apply, for example by mentioning the product in a corner or embedded in the line as for the graphical indexes (see C-12.2.1 and C-12.2.2).

For gridded data, the no-data area limits do not need to demarcate areas within the grid extent which are covered by fill values.

**Implementing the depiction of limits for data other than S-101 and S-57 ENCs is optional.**

NOTE: For some types of coverage products (for example gridded data), no-data areas may be easily distinguished by the lack of portrayal. Nevertheless, consistent treatment of products is recommended for the convenience of the mariner - either this clause should be implemented for all t he non-ENC S-100 products, or for none of them.

### 

## ~~Deleted~~

## Special ECDIS chart symbols to identify unsafe depths

The ECDIS highlights four features that are important for safe navigation. These are the safety contour, depth shades, the safety depth and isolated dangers

### Safety Contour

The own-ship safety contour, selected by the mariner from among the contours in the System Database, is double-coded by a thick line and a prominent change in depth shade.

If the safety contour selected by the mariner is not available in the System Database, the ECDIS must default to next deeper contour and **inform the mariner**. If, when the ship moves onto a new chart, and the safety contour previously in use is no longer available, the ECDIS must again select the next deeper contour, and **inform the mariner**.

If the mariner does not select a safety contour, the value must default to 30 metres.

## Other ECDIS symbols and their use

### Mariners Caution Notes

Point cautions and notes entered by the mariner and the manufacturer are distinguished by the colours orange and yellow respectively.

### ~~Deleted~~

### ~~Deleted~~

### Manual chart correction

*Small orange identifiers are used to distinguish hand-entered chart corrections, which are subject to human error, from corrections entered automatically by electronic means. The original chart feature should not be removed or altered.*

The specification and portrayal of Manual Chart Corrections is defined in Annex XX

### *Manual corrections to non-ENC S-100 products*

*Manual corrections to other S-100 products are entered in the same way as chart corrections. They are not visually distinguished from manual chart corrections. However, for portrayal purposes they are treated as part of the appropriate product data rather than the S-101 data and are displayed or removed from the display along with the appropriate viewing groups from the relevant S-100 product.*

### ~~Deleted~~

### ~~Deleted~~

## Date-dependent features

There are a number of features within the Marine environment, which are seasonal, such as racing buoys. These features are only to be displayed over a certain period, S-101 uses the complex attribute *periodicDateRange* with the sub attributes *dateStart* and *dateEnd* to indicate the periodic nature of the feature. Other features, such as traffic separation schemes, use the complex attribute *fixedDateRange* with the sub attributes *dateStart* and *dateEnd* to indicate their introduction or removal. In order for the Mariner to receive important changes to traffic separation schemes before the event, HOs are required to provide updates or new editions containing the alterations at least one month before they come into force. Any S-101 feature with one of the above complex attributes must not be displayed outside its effective dates unless requested by the Mariner.

### Display of date-dependent features by mariner-selected date

To provide the Mariner with effective route planning capabilities and for the look-ahead function during route monitoring ECDIS must display date dependent chart data based on a Mariner selected date or date range (start viewing date and end viewing date).

During route planning and monitoring the Mariner must be able to select a date or date range to display all date dependent chart features.

EXAMPLE: A new traffic separation scheme is coming into effect on 01.01.2013, it has been encoded by the ENC producer using the attribute *dateStart*. The current date is 12.12.2012 and the Mariner is planning a route that will cross this area over the effective start period.

The ECDIS must be capable of providing the Mariner the ability to set the date the vessel will be in the area (e.g. 02.01.2013 in the above example) and the system should show the new traffic scheme.

### ~~Deleted.~~

### Indication of date adjustment

When viewing date or date range do not include the current date, the mariner must be informed by a permanent indication on the chart display that the date has been adjusted. The indication must begin with the text “Display Not Real Time” and the selected date or date range must be readily available. The format of the date must be: dd mmm yyyy = Day, Month, Year; for example, 28 Jan 2014.

The use of one of the following formats is recommended:

* Display Not Real Time – Display is based on date dd mmm yyyy
* Display Not Real Time – Display is based on viewing date range from dd mmm yyyy to dd mmm yyyy

## ~~Scale-dependent features~~ [Decluttering the screen]…

To reduce screen clutter some features within ENC carry the attribute *scaleMinimum* to specify the smallest display scale at which they to be portrayed. At display scales smaller than *scaleMinimum* the drawing instructions output from the portrayal engine are not drawn.

For example, the drawing instructions for a feature with a *scaleMinimum* value of 49999, (indicating a display scale of 1/49,999), are not be drawn on an ECDIS with a display scale of 1/50,000.

## IMO presentation elements

In some cases S-101 does not provide a symbology instruction in the Portrayal Catalogue that specifies how to present a specific feature on the ECDIS screen. The reason is that such a feature cannot be clearly identified as an S-101 feature class or it appears to be illogical to include it to the Mariners' navigational feature classes.

The following presentation instructions are therefore provided in order to assist the manufacturer to set up a satisfactory and comprehensive ECDIS display.

### Scale bar and latitude scale

The IMO Performance Standards require an indication of scale and range as part of the Display Base. The display scale determines which must be used:

1. Case 1: for display scales larger than 1/90,000: always display the 1 Nautical Mile scale bar provided in the Portrayal Catalogue
2. Case 2: for display scales at 1/90,000 or smaller: always display the 10 Nautical Miles (at latitude) scale provided in the Portrayal Catalogue.

The scale bar or latitude scale must always be drawn vertically at the left side of the chart display, just clear of the border of the display. The symbols and drawing parameters are described in Table C-21.

The placement should be 3mm in from the border of the display. Make sure the symbol is properly sized by your software to represent 1 nautical mile at the scale of the display (for Case 1) or 10 nautical miles at the scale of the display (for Case 2).

| **Scale range** | **Symbol** | **Drawing priority** | **Display plane** | **Display category** | **Viewing group** |
| --- | --- | --- | --- | --- | --- |
| 1:89999 and larger scale | SCALEB10 | 90 | OverRadar | Display Base | 11030 |
| 1:90000 and smaller scale | SCALEB11 |

Table C-21 - Scale bar presentation parameters

EXAMPLE 1: For *display scales* larger than 1/90,000 (for example, a scale of 1/50,000) draw symbol 'SCALEB10' on the left side of the chart display, bottom justified and 3mm in from the border of the display. Make sure the symbol should be sized to represent 1 nautical mile (1852 m) at the scale of the display.

EXAMPLE 2: For display scales of 1/90,000 or smaller (for example, 1/250,000) use symbol 'SCALEB11', similarly located, and scaled to represent 10 miles at the scale of the display.

IEC define a requirement for indicating the location at which the scale is calculated under certain circumstances, as follows:

If the displayed area together with the used projection is such that scale is not uniform over the displayed area then the scale bar (more than 5% difference in uniformity for all directions or displayed area is over latitude 70º) or latitude scale (more than 5% difference in uniformity for latitude direction or displayed area is over latitude 70º) shall indicate the scale either at own ship location or at the centre of the displayed area. In such case a permanent indication “at own ship” or “at centre” shall be close to the scale bar or latitude scale. [IEC 61174:2015].

### North arrow

The IMO Performance Standard requires a north arrow as part of the Display Base. The north arrow must always be shown at the top left corner of the chart display, just clear of the scale bar or latitude scale. Other requirements for the north arrow are defined in IEC 61174.

The symbol 'NORTHAR1' must be used to indicate true north. It must be placed in the top left corner of the chart display, on the inner side of the scalebar. It must be rotated to true north if the display is other than north up, and clear of the scalebar even if the latter extends the full height of the display.

~~The symbols and drawing parameters for the north arrow are described in the IHO GI Registry.~~

| **Symbol** | **Drawing priority** | **Display plane** | **Display category** | **Viewing group** |
| --- | --- | --- | --- | --- |
| NORTHAR1 | 90 | OverRadar | Display Base | 11030 |

Table C-22 – North Arrow presentation parameters

### Graticule

If the ECDIS shows a graticule (listed in “other information” in IMO Performance Standards (MSC.530(106)) the lines should use the colour token CHBLK.

### Display mode

The ECDIS manufacturer must provide the indication of display mode required in the display base by IMO Performance Standards (MSC.530(106) Appendix 2).

### ~~Deleted~~



### Black level adjustment symbol

Unless the brightness and contrast controls of the monitor are properly adjusted there is a danger that information may be lost from the chart display, particularly at night. Symbol BLKADJ is provided for checking correct adjustment and for re-adjusting as necessary. The BLKADJ symbol is provided as a part of ECDIS Chart 1, see section XXX

### Detection and notification of navigational hazards

The IMO Performance Standard for ECDIS MSC.530(106), clause 11.3.5 Route planning states:

A graphical indication should also be given if the mariner plans a route closer than a user-specified distance from a user-selectable category of point objects, such as a fixed or floating aid to navigation or isolated danger..

Clause 11.4.6 Route monitoring states:

ECDIS should give a warning or caution or indication as selected by the mariner and related graphical indication if, continuing on its present course and speed, over a specified time or distance set by the mariner, own ship will pass closer than a user-specified distance from a user-selectable category of danger (e.g. obstruction, wreck, rock) that is shallower than the mariner's safety contour or a user-selectable category of aid to navigation.

Clause 11.4.8 Route Monitoring states:

A graphical indication should be given if the current or the next leg of the selected route goes closer than a user-specified distance from the boundary of a user-selectable category of prohibited area or a geographic area for which special conditions exist. The ECDIS must implement support for the Alert and Indications Catalogue which may be provided within each product’s Portrayal Catalogue.

The safety contour value is set by the user; in the absence of a user setting, its default value must be 30m.

The highlight must indicate the intersection between the ship’s look-ahead buffer (computed using speed, course, look-ahead time and cross-track deviation) and the spatial components associated with alert instructions output by the portrayal.

[**harmonise with next section – portrayal name]**

Figure C-2 depicts indication highlights for points, curves, and surfaces.



Figure C-2 - Examples of indication highlights

### Detection of areas for which special conditions exist

The IMO Performance Standard for ECDIS MSC.530(106), clause 11.3.5 (which applies to Route Planning) states:

A graphical indication should be given if the mariner plans a route closer than a user-specified distance from the boundary of a user-selectable category of prohibited area or geographic area for which special conditions exist (see appendix 4).

Clause 11.4.4 Route Monitoring states;

ECDIS should give a warning or caution, or indication, as selected by the mariner, and related graphical indication if, within a specified time or distance set by the mariner, own ship will pass closer than a user-selected distance from the boundary of a user-selectable category of prohibited area or of a geographical area for which special conditions exist (see appendix 4).

The ECDIS must implement support for Alert and Indications Catalogues.

### Definition of safety contour

The safety contour is defined as the boundary between safe and unsafe areas of the display.

### Detection of safety contour

The IMO Performance Standard for ECDIS MSC.530(106), clause 11.3.4 Route Planning states;

A graphical indication is required if the mariner plans a route closer than a user-specified distance from own ship's safety contour..

Clause 11.4.3 Route Monitoring states;

It should be possible to select that ECDIS gives an alarm and related graphical indication if, within a specified time or distance set by the mariner, own ship will pass closer than a user-selected distance from the safety contour..

Clause 11.4.7 Route Monitoring states:

A graphical indication should be given if the current or the next leg of the selected route passes closer than a user-specified distance from the safety contour.

The ECDIS must implement support for Alert and Indications Catalogues

The point, curve or surface must be graphically indicated using the presentation named as “DNGHLT” in the S-101 Portrayal Catalogue, as depicted in Figure C-3.

*[How do we highlight the other geometry cases (coverage data)]*



Figure C-3 - Examples of danger highlights in ECDIS

**[INSERT text for use of quality information when agreed]**

### User Selected Safety Contour and Water Level Adjustment.

User selected safety contour means the creation of the safety contour from bathymetric grid data based on a value set by the user. With ENCs the user sets a value for the safety contour, but if the exact fit is not found from the available depth information in the ENC then the safety contour defaults to the next deepest which can be substantially deeper than the value requested by the user.

Bathymetric grid data allows the user the ability to define a value and for the system to delineate areas of safe and unsafe water based on that value. The areas defined can then be used for the definition of safety contour and attendant alerts/indications. When this is done contextual ENC features with depth information are also substituted from the bathymetric grid to present the user a harmonised picture.

The combination of S-101 with S-102 and S-104 together enable Water Level Adjustment (WLA), allowing the water level data contained in S-104 to complement the S-102 and S-101 chart data. As with depth information, WLA processes adjust attribute values in the ENC data to present the user with a harmonised picture.

Appendix C-4 defines the detailed mechanisms for user selected safety contour and water level adjustment.

### ~~Deleted~~

### ~~Deleted~~ ~~Detection of route-based conditions~~

## Data Producer specified display features

### ~~Deleted.~~

### ~~Deleted.~~

### ECDIS Legend

The ECDIS chart legend containing the following elements must be available for display of values derived from a position selected by the Mariner.

Table C-23 indicates which ENC data elements must be used.

| **ECDIS Legend Item** | **Values** |
| --- | --- |
| Units for depth | Axis Unit of Measure (AXUM) subfield in the Coordinate System Axes (CSAX) field |
| Units for height | AXUM subfield in the CSAX field |
| Although the S-101 ENC Product Specification does not allow any units other than metres for depths and heights, these two elements must be stated for clarity for the Mariner | |
| Scale of display | Selected by mariner |
| Data quality indicator | 1. zoneOfConfidence.categoryOfZoneOfConfidence (CATZOC) attribute of the **Quality Of Bathymetric Data** (M\_QUAL) meta-feature.   When multiple temporal attributes are present:  - If a single attribute value is valid for the selected viewing date range, that value must be displayed.  If multiple values are valid for the selected viewing date range, the worst-case value must be displayed.  When multiple features are present (to indicate bathymetric data quality at various depths):  - The feature which intersects the specified safety contour value must be used.  (b) Total *horizontalPositionUncertainty* of the **Quality Of Non-Bathymetric Data** (M\_ACCY) meta-feature if available. |
| Note: Due to the way quality is encoded in the ENC, both values (a and b) must be used | |
| Sounding/vertical datum | The *verticalDatum* attribute of the **SoundingDatum** feature and **VerticalDatumOfData** feature when available.  (*verticalDatum* attributes of individual features must not be used for the legend.) |
| Horizontal datum | WGS84 |
| Value of safety depth | Selected by Mariner. Default is 30 metres |
| Value of safety contour | Selected by Mariner. Default is 30 metres |
| If the Mariner has selected a contour that is not available in the ENC and the ECDIS displays a default contour, both the contour selected and the contour displayed must be quoted | |
| Magnetic variation | **MagneticVariation** (MAGVAR) feature, attributes:  *referenceYearForMagneticVariation (RYRMGV)*,  *valueofAnnualChangeInMagneticVariation (VALACM)*,  and *valueOfMagneticVariation (VALMAG)*  Item must be displayed as: VALMAG RYRMGV (VALACM)  For example, 4°15W 1990 (8’E) |
| Date and number of latest update affecting the ENC dataset currently in use | Issue date and update number from the dataset discovery record (S100\_DatasetDiscoveryMetadata) of the last update dataset applied. (See S-100 Part 17) |
| Edition number and date of the ENC currently in use | Edition number and issue date from the dataset discovery record (S100\_DatasetDiscoveryMetadata) of the current base issue of the ENC dataset. (See S-100 Part 17) |
| Chart projection | Projection used for the ECDIS display (For example, oblique azimuthal). This should be appropriate to the scale and latitude of the data in use |

Table C-23 - Legend elements

The list above is the minimum that should be available, but the complete list need not always be shown. Individual items may be picked by the mariner for display for a period; examples are magnetic variation, data quality for depths, etc.

## Displaying manual and automatic updates and added information

### Manual update

Manual updates of ENC information must be displayed using the same symbology as ENC information and must be distinguished from ENC information as described in the following sub-clauses.

#### Added feature (manual)

Point feature: Superimpose symbol CHCRID01.

Curve feature: Overwrite with line style CHCRID01.

Surface feature: Overwrite area boundary with line style CHCRID01 and superimpose symbol CHCRID01 on any centred symbol.

#### Deleted feature (manual)

The feature must remain on the display and be marked as follows:

Point feature: Superimpose symbol CHCRDEL1.

Curve feature: Overwrite with line style CHCRDEL1 (do not remove the original line).

Surface feature: Overwrite area boundary with line style CHCRDEL1 and superimpose symbol CHCRDEL1 on any centred symbol.

#### Moved feature (manual)

As for deleted feature, followed by added feature.

#### Modified feature (manual)

There are three cases, which are treated as follows:

1. If the only modification is an addition (for example, an existing buoy has a retro-reflector added with no other change):

Superimpose symbol CHCRID01 or line style CHCRID01.

1. If the only modification is a deletion of a part (for example, an area has a «fishing prohibited» restriction removed), then this creates both a change and a deletion and both must be symbolized:

Point: Superimpose symbol CHCRID01 and symbol CHCRDEL1.

Line: Overwrite with line styles CHCRID01 and CHCRDEL1.

Area: Overwrite the boundary with line styles CHCRID01 and CHCRDEL1 and also superimpose symbols CHCRID01 and CHCRDEL1 on any centred symbol.

1. If the modification is an addition and a deletion then it is handled as in (b) above.

A deleted feature must appear on the display only when its IMO category and viewing group are displayed.

A manually updated feature must be capable of the same performance in feature selection, response to cursor-picking, etc, as an ENC feature. In addition, it must provide updating information (identification and source of update, when and by whom entered, etc) on cursor picking.

### Identifying automatic chart corrections on demand

The ECDIS manufacturer must provide a means of identifying chart corrections to the System Database on demand by the Mariner.

On Mariner demand automatic chart corrections of ENC information must be highlighted as described in the following sub-clauses.

***[missing a table for presentation parameters for drawing instructions, adapt this one?]***

| **Symbol** | **Drawing priority** | **Display plane** | **Display category** | **Viewing group** |
| --- | --- | --- | --- | --- |
| CHRVID01 | XX | OverRadar | Display Base | XXXXXX |

Table C-22 – Automatic Chart Corrections

#### Added Feature (automatic)

Point object: Superimpose symbol CHRVID01.

Curve object: Overwrite with line style CHRVID02.

Surface object: Overwrite area boundary with line style CHRVID02 and superimpose symbol CHRVID01 on any centred symbol.

#### Deleted Feature (automatic)

Point object: Superimpose symbol CHRVDEL1.

Curve object: Overwrite with line style CHRVDEL2 (do not remove the original line).

Surface object: Overwrite area boundary with line style CHRVDEL2 and superimpose symbol CHRVDEL1 on any centred symbol.

#### Moved Feature (automatic)

As for deleted feature, followed by added feature.

#### Modified Feature (automatic)

Point: Superimpose symbol CHRVID01 and symbol CHRVDEL1.

Curve: Overwrite with line styles CHRVID02 and CHRVDEL2.

Surface: Overwrite the boundary with line styles CHRVID02 and CHRVDEL2 and also superimpose symbols CHRVID01 and CHRVDEL1 on any centred symbol.

#### Non-HO (Non-ENC) Chart Information

Limited non-HO data added to existing HO ENC data to augment the chart information must be distinguished from the HO ENC information as follows:

Point object: Superimpose symbol CHCRID01.

Curve object: Overwrite with line style CHCRID01.

Surface object: Overwrite area boundary with line style CHCRID01 and superimpose symbol CHCRID01 on any centred symbol.

#### Update Information

***These aren’t needed. What is needed is the mechanism of control for these features, if one exists? Unlike automatic updates there’s no mechanism for their “acceptance”?***

***[Should there be a requirement to switch between the two methods of visualising updates, or turn them on/off independently of each other]***



### Updating non-official chart information

Limited non-official data added to existing official ENC data to augment the chart information should be distinguished from the official information as follows:

Point feature: Superimpose symbol CHCRID01.

Curve feature: Overwrite with line style CHCRID01.

Surface feature: Overwrite area boundary with line style CHCRID01 and superimpose symbol CHCRID01 on any centred symbol.

Non-official data should be distinguished from manually updated chart information, which uses the same identifiers, by cursor picking.

Non-official chart information may be updated by any systematic procedure. A record of updates should be maintained.

The mariner should be able to remove all non-official chart information if the need should arise.

### Other non-official data

Non-official data must be distinguished from manually updated chart information, which uses the same identifiers, **by cursor picking**.

See clause C-9.1.3 for information on how to symbolize other cases of non-HO data appearing on the ECDIS display.

Non-official chart information may be updated by any systematic procedure. A record of updates must be maintained.

The Mariner must be able to remove all non-HO chart information if the need should arise.

## ~~Deleted.~~

### Display and Management of Navigational Warnings

S-124 Navigational Warnings (NAVWARN) portrayal is provided by a portrayal catalogue that includes a symbol set and symbol instructions for the feature and attribute combinations.

### Additional Portrayal requirements of the Graphical User Interface

A dedicated interface must be provided to allow users to interact with NAVWARN messages. This interface must, at a minimum, provide functionality for;

1. The user must be able to tag individual messages according to the filtering requirements in section 12.3.
2. A Capability for an on demand listing of all (S-124) NAVWARN messages in the system, and sorting these according to: received date and time, issue date and time, warning type, producer and series, must be provided. Additionally, a means to list according to user classification should be provided.
3. Provide an indication when a new NAVWARN message is received until it has been displayed or 24 hours have passed. This indication may be suppressed if the NAVWARN message does not meet filtering criteria set by the mariner (see 12.3).
4. Means must be provided for the operator to enter criteria for filtering of indication of new NAVWARN messages based on time and maximum distance from own ship, monitored route or planned route (see 12.3). Default setting must be no filtering.
5. Details of the filtering options that have been enabled by user must be readily available for inspection and modification.
6. Means must be provided to view the most recent message, past messages, and to view messages associated with selection of NAVWARN symbols in the graphical display area.
7. Listing of all NAVWARN must include means for viewing an abbreviated view of any **NAVWARNPart**, **warningInformation** attributes present.

***NOTE: It may be possible to create some of this functionality via portrayal context parameters,***

### Filtering Navigational Warning information

S-124 navigational warnings datasets are intended for use in S-100 ECDIS as elements of an “always on” layer conforming to S-98 Level 1 interleaving when interoperability is enabled.

There is a risk of clutter with this level of interoperability and it is therefore necessary to include filtering functionality for the user, to aid the removal of non-relevant information from the portrayal.

NOTE: Even though the full extent of a navigational warning may not portrayed, it must still be available and discoverable in a list of NAVWARNs that can be recalled by user action at any time.

User systems should therefore provide filtering mechanisms for the Navigational Warning information.

At a minimum, filtering functionality must be included that allows the user to classify the relevance of a NAVWARN against the intended route as:

* on chart (relevant for the route, must always be visualized), or;
* off chart (not relevant for the route, and need not be visualized), or;
* information (relevant for the route, but for information and need not be visualized).

On chart should be the default classification for all NAVWARNs.

Additional filtering functions may include options such as;

* Filtering on route with a buffer;
* Navigational warning topic;
* Date range of the hazard;
* Valid time of the navigational warning.

These filters could be used to assist the navigator in classifying a NAVWARN according to its relevance for the route.

**Example 1:** A self-cancelling dataset :

**NAVWARNPreamble**

**publicationTime** of 20230704T010000Z

**cancellationDate** of 20230711T000000Z

**NAVWARNPart fixedDateRange** of 20230706T010000Z to 20230710T010000Z

is visible on navigation screen during 20230706T010000Z to 20230710T010000Z, unless removed by a filter set by user, and optionally visible during 20230704T010000Z to 20230706T005959Z.

Note: It is still be possible for user to recall cancelled messages for review purposes.

**Example 2:** Any dangers that are in waters too shallow for the ship get classified as off chart warnings, but are discoverable in the on demand listing of active NAVWARNs.

### Cancelled datasets

When the S-124 dataset is cancelled it must not be displayed on the navigation screen, but should be available for review in the on demand listing of NAVWARNs in the navigation system and marked as cancelled.

### Portrayal of feature classes

The **NAVWARNAreaAffected** class does not have a portrayal defined to avoid causing significant cluttering on the navigation screen. Rather, the feature must be highlighted by the system if selected from a pick report or by other means for interrogation by user.

When a **NAVWARNPart** is not portrayed, such as when user selections mark it not to be visualized, any associated **TextPlacement** features must also not be portrayed.

…...

# Coverages and Time Series

Coverage and time series features are encoded in the HDF5 format (see S-100 Part 10c). S-100 provides for the following types of coverage and time series data:

* Gridded data with different types of spatial grid coverages;
* Triangulated irregular network (TIN) data;
* Data at a set of discrete fixed points;
* Data at a set of moving platforms;
* Time series data at a set of fixed points.

Gridded data will specify either continuous or discrete[[1]](#footnote-6) interpolation between grid points. Data for discrete fixed points, moving platform and time series at fixed points is intrinsically discrete.

## Discrete coverages

Cursor queries within the extent of a grid should produce a Pick Report displaying the attributes and values at the grid data points. The neighbourhood for cursor query should correspond to the visual effects of the portrayal, for example:

* A box of dimensions one-half the grid spacing along each axis.
* The same value and geometry (box, circle, etc.) as for point features in the ENC.

Thinning for display at a smaller scale should also be taken into account, and the result should include data from.

In the absence of a prescription in the Product Specification for how the neighbourhood is to be determined, manufacturers may use any suitable method of their own devising.

## Continuous coverages



Cursor queries within the extent of a continuous coverage feature should produce a Pick Report displaying the attributes and values at the location of the cursor query. The interpolation method specified in the Product Specification should be applied.

In the absence of a prescription in the Product Specification for the values to be returned for a cursor query, manufacturers may determine the values using any suitable method of their own devising, consistent with the requirements of this clause.

## Contours from continuous coverages

The addition of S-102 datasets enhances the Mariner’s ability to render and display, using colours, higher resolution depth zoning directly from the gridded data in S-102.

At time of ingest a display system should delineate navigational depth zones by comparing the depth layer of the S-102 dataset to the Mariner defined vessel draft or default safety contour.

## Transparency

The symbol transparency must be adjusted according to the background chart/image used.

## Thinning

When gridded data is portrayed using discrete symbols at each data point, the effects of scaling the display must be considered. A high-resolution display (that is, zooming in) of regularly gridded data display produces a lower density of data in the visual field. Recommendations in the Product Specification as to whether spatial interpolation may be used to estimate data values at locations between grid points or point coverage locations must be followed.

Displaying at a low resolution (that is, zooming out) increases the density of symbols in the visual field. However, by applying a thinning algorithm, the number of symbols may be reduced.

This Specification requires only that a thinning algorithm be applied to reduce symbol density when the display is scaled. Manufacturers may use the algorithms described below or other algorithms of their own devising.

### Thinning algorithms (informative)

#### Regularly gridded data

Let the grid cell’s diagonal for the unthinned grid at the current display scale be given by *D* mm. Note that *D* is dependent on the dataset and the characteristics of the viewing monitor. If every *nth* cell is displayed, the displayed spacing is *nD*. Next, suppose the maximum dimension of the largest scaled symbol in the displayed field is *Lsmax* mm. Then the ratio *R* of the maximum symbol dimension to the displayed grid spacing is constrained to be less than a prescribed maximum value, *Rmax*. A typical value for *Rmax* can be taken to be 0.5. (Given that on a navigation display there may be point features from other products within the extent of the grid, *Rmax=0.5* may be too high for practical use; the optimal value of *Rmax* is left to manufacturer determination, and may be different for different products, depending on the shape of the symbol.) Then the following inequality must be satisfied for the thinned grid:

If the above inequality cannot be met with increment *n* equal to 1, then a new value for *n* is computed by the following formula:

Where *fix()* is a function that returns the truncated integer value of its argument. For plotting, arrows at every *nth* column and every *nth* row are drawn, making sure that the row and column with the maximum-size symbol is drawn. The value of *n* must be calculated by the system. It also requires identifying a “seed point,” a grid point with the maximum-size symbol from which counting starts. Designating this seed point as *(x0, y0)*, the grid points where symbols are drawn are given by:

This algorithm assumes the grid spacing can be represented by its cell diagonal. It can be adapted to allow for symbols that are aligned parallel to grid axes or for rectangular cells.

The Figures below illustrate the use of this algorithm. Figure 5 depicts a grid coverage feature symbolised by arrows of dimensions varying according to the value of an attribute at the grid point. Figure C-6 depicts the same data thinned with *Rmax* = 0.5 (outline-only arrows are suppressed). Figure C-7 depicts the thinning of the same data with *Rmax* = 0.33. The nominal[[2]](#footnote-7) dimensions and parameters for the three cases are:

Grid spacing at the display scale (*D*): 36mm (grid diagonal).

Scaling of symbols by data attribute values at grid points produced symbols of four sizes (arrow length):

* L0 = 30.4mm = *Lsmax*
* L1 = 17.7mm
* L2 = 16.2mm
* L3 = 12.7mm



Figure 5 - Grid without thinning

For *Rmax* = 0.5, with *n* = 1, the value of *R* is greater than *Rmax*:

Applying the formula for computing *n*:

Counting in row-major order from the grid origin *(0,0)*, the first symbol of size *Lsmax* is located at *(1,1)*. Denoting this point as the seed point *(x0, y0)*, the only grid points where symbols are displayed are:

The results are depicted in Figure C-6.



Figure C-6 - Grid thinned with *Rmax* = 0.5

For *Rmax* = 0.33, the formula for *n* yields:

and

The results are shown in Figure C-7.



Figure C-7 - Grid thinned with *Rmax* = 0.33

The algorithm may hide significant characteristics of the data; for example, counting displayable rows and columns starting with the first instance of a maximised symbol may suppress significant information in nearby grid points and produce the wrong overall impression. In Figure C-6, row 2 would be suppressed even if all the data points in that row are of the same size as the symbol at (1,1) — this would suppress more data points with scaled-up symbols, which may represent data of more significance to the Mariner.

Grid diagonal as a measure of cell spacing is more suitable for grids where cell dimensions along both axes are approximately equal in display units (that is, in millimetres at the display scale); if there are significant differences, the *D* and *Rmax* parameters will need to be different for the two axes.

Execution of this algorithm would be faster if the grid coordinates of the seed point *(x0, y0)* are known in advance, either encoded by the producer as instance metadata, or calculated when the dataset is ingested into the system. S-100 does not yet provide a standard way of encoding this information.

Manufaturers may extend or adapt this algorithm in various ways, for example:

* Adapt *Rmax* to the shape and proportions of the symbol (that is, its perceived effect on the display).
* For grids with cells whose dimensions in display units are very different along different axes, use different *D* and *Rmax* parameters for the two axes, giving different values of *n* for different axes.
* Pre-compute and cache the scale values where *n* changes, so that suppression or revelation of symbols can be determined by the scale of the display.
* Adapt the determination of the seed point to show as many significant values as possible.

In order to avoid confusing the mariner, reasonable consideration should be given to generally maintaining the regular appearance of the grid coverage, though some irregularity is probably unavoidable with greater thinning.

## Temporal variation

The metadata variables related to time are *dateTimeOfFirstRecord*, *dateTimeOfLastRecord*, *timeRecordInterval*, *numberOfTimes, timeIntervalIndex, timePoint, startDateTime,* and *endDateTime* (see S-100 Part 10c). The time selected for display (that is, past/present/future) will typically not correspond exactly to the timestamp (metadata variable *timePoint*) of the input data. For a correct display, the ECDIS will have to select the correct data.

For data with only a single timed record (where the timestamp of the earliest value equals that of the latest value) such as real-time data, the data values are displayed only if the display time is later than the timestamp and the absolute time difference between the display time and the data timestamp is less than a discrimination interval (for example 5 minutes). For a single record, the variable *timeRecordInterval* can be used to set the discrimination interval.

For data with multiple times, if the selected display time is later than the first timestamp and earlier than the last timestamp, or the selected display time is in the interval [*startDateTime,* *endDateTime]*, then the closest but immediately preceding values in the data are displayed. However, if the selected display time is earlier than the first timestamp, or outside the interval [*startDateTime*, *endDateTime*] then the data is not displayed. If the selected time is later than the last timestamp or after *endDateTime*, then data values at that time are displayed only if the absolute time difference between the display time and the data timestamp is less than a discrimination interval (for example the value of the variable *timeRecordInterval*).

Some data change rapidly, so more-or-less continual revision or updating of such data is essential. For real-time observations, new values are periodically collected (for example, on the order of once every 5 minutes).

For a forecast, the entire field may be created one or more times per day.

New issues of real-time observations or forecasts may not be considered as new editions, but as new datasets. New datasets may be distinguished by a unique datetime in the file name.

New editions may be encountered in predicted time series data.

Other data, such as tidal atlas or harmonic constant data are updated much less often, typically on an annual basis.

The system should check for the availability of new data at a frequency that matches the update frequency.

# Colours

## General

In Portrayal Catalogues, colours are specified in one or both of CIE (Commission Internationale de l'Eclairage) or sRGB colour space coordinates[[3]](#footnote-8). CIE colour specifications use xy chromaticity coordinates and luminance L. The sRGB colour space (IEC 61966-2-1) defines colours in terms of the chromaticities of red, green, and blue primary colours.

The ECDIS colour scheme is based on specification of colour tokens and color conversion tolerances.

Note that these colour specifications apply to both the operational chart display (for route planning and route monitoring), and also to any text on the same screen as the chart display.

## Selection of colours

Since chart and navigation lines and symbols must show clearly against the background shades, the colour palettes were constructed by first selecting the background area shades and then selecting colours for lines and symbols that contrast with their background. In selecting foreground colours for point and line features, lines and symbols, the aim has been to highlight important information by giving it greater contrast with the background.

In order to accommodate the very large change in bridge lighting between bright sun and dark night, the colours switch from a light background with dark foreground details, which has been found to give the best contrast under bright sun, to a dark background with light foreground details by night. The night display has to be dim enough that it can be viewed without impairing the Mariner's night vision. The Dusk table is also a black-background table, for optional use by day as well as at twilight.

The design of both colours and symbols has concentrated on ensuring that important chart and navigation features remain clearly visible under the extremes of bright sun and dark night viewing.

## Colour palettes implemented by the portrayal catalogue

There are three colour palettes, all of which should be made available to the Mariner. They are specified as part of the colour profile file(s) in the Portrayal Catalogues. They are as follows:

DAY The "Day" palette uses a white background as a result of a comparative test outdoors in bright sunlight which showed that a display background of maximum luminance gives the best contrast achievable under near-washout conditions. This conclusion has been confirmed by subsequent sea experience.

DUSK The "Dusk" colour palette is based on using a black background; this palette may also be used by day as a Mariner's option.

NIGHT The “Night” colour palette is intended for nighttime use. At night the light emitted by the display must be strictly limited to avoid impairing night vision. In case the luminance needs to be further reduced, the "Night" colour palette may be augmented by a luminance-reducing neutral density filter which should have 8 times attenuation, designated (logarithmically) "0.9 ND". (This is a manufacturer's option.)

## Transparency

### Use of transparency (informative)

Transparent area colour fill is used for the following purposes:

1. So that the background colours, lines and symbols show through an area shade (for example, depth shades and contours should show through a traffic separation zone);
2. To reduce the prominence of a large symbol (for example, too prominent a centred anchorage area symbol would cause clutter on the display);

When interoperability processing is activated, interoperability rules should take precedence over the purposes above in case of conflict; but if transparency for the above purposes can be used without overriding an interoperability rule, it should be used.

## Colour assignment for navigation systems

### Introduction to colours (Informative)

Since chart and navigation lines and symbols must show clearly against the background shades, the colour tables were constructed by first selecting the background area shades and then selecting colours for lines and symbols that contrast with their background. In selecting foreground colours for point and line features, lines and symbols, the aim has been to highlight important information by giving it greater contrast with the background.

In order to accommodate the very large change in bridge lighting between bright sun and dark night, the colours switch from a light background with dark foreground details, which has been found to give the best contrast under bright sun, to a dark background with light foreground details by night. The night display has to be dim enough that it can be viewed without impairing the mariner's night vision. The Dusk table is also a black-background table, for optional use by day as well as at twilight.

The design of both colours and symbols has concentrated on ensuring that important chart and navigation features remain clearly visible under the extremes of bright sun and dark night viewing.

### Colour assignments

The general colour assignment for navigation systems is provided below.

| **Colour** | **Usage** |
| --- | --- |
| black/white | (black by day / white by night) is used for critical navigation features which need highlighting by contrast against their background to give them adequate prominence. Examples are the own-ship symbol, dangerous soundings equal to or less than the safety depth, buoys, conspicuous objects on land etc. It is also used for text, which is less clear in any other colour. |
| white/black | (white by day / black by night) as a background area shade is used for deep, safe, water. |
| magenta | is used to highlight critically important features such as isolated dangers, traffic routes, anchorages; and for restricted areas, submarine cables, gas pipelines etc. It is also used for aids to navigation and services such as daymarks, racons, and pilot stations. |
| grey | is used for many features which are black on the paper chart. It is used with thick lines for critical physical objects such as bridges and overhead cables, and with thin lines for important but less critical physical features such as non-dangerous soundings, sandwaves, overfalls, water pipelines and fish farms. It is similarly used for chart features such as fairways, harbour areas, tidal information and for information about the chart such as quality of chart data, overscale areas, etc. |
| grey | as a background area shade is used with a prominent pattern for no-data areas. |
| blue | as a background area shade is used to distinguish depth zones. |
| blue | as foreground colour for AIS and VTS information; also reserved for future requirements. |
| green | is used for the radar image and synthetics, and for buoy and lights colours. |
| blue-green | is used for transferred ARPA. |
| yellow-green | ('moss-green') as a background area shade is used for the intertidal area between high and low waterlines. |
| yellow | is used as the manufacturer's colour; for the Mariner's transparent colour fill; and for buoy and lights colours. |
| red | is used for the important planned route, for the Mariner's danger highlight, and for buoy and lights colours. |
| orange | is the Mariner's colour, for notes, chartwork, chart corrections. The scale bar, north arrow, and Mariner's navigation objects such as EBLs and VRMs are also orange. |
| brown | as a background area shade is used for the land, and dark brown is used for features on land and in the intertidal area that do not have any strong significance for navigation. |

Table C-26 - General colour assignments

## Colour tokens, profiles and palettes [Informative]

Colour tokens and colour profiles should be registered in the Portrayal Register in the IHO GI Registry prior to use in Portrayal Catalogues. The same colour tokens may be used by different data products. Product Specifications should use the same colour tokens as S-101 for feature types and sub-types that are conceptually similar to S-101 feature types.

The colours in this section are specifically designed for chart display.

Table C-27 lists colour tokens used in ECDIS displays and describes their roles and significance. This table is not a comprehensive list of colour tokens; see the colour profile files in the Portrayal Catalogues of individual products for the full list of colour tokens used by each product.

NOTE: This table is useful information for implementations and should be available to implementors for completeness. It should also be kept updated with information pertaining to other Product Specifications. It is provided as part of this edition because there is at present no apparent provision for publishing it as a “living document”. Future editions may replace it by a reference to a “living document” in the IHO GI Registry or on the IHO Web site.

| **Token** | **Colour, day/night** | **Usage** | **Significance** |
| --- | --- | --- | --- |
| ***Colours for chart features*** | | | |
| CHBLK | black/grey | general | This selection of colours is used in general to design symbols and chart line features as well as fill styles. They are not used in cases where other colours are available for a special usage. |
| CHGRD | grey dominant | general |
| CHGRF | grey, faint | general |
| CHRED | red | general |
| CHGRN | green | general |
| CHYLW | yellow | general |
| CHMGD | magenta, dominant | general |
| CHMGF | magenta, faint | general |
| CHBRN | brown | general |
| CHWHT | white | general |
| OUTLW | black | symbol outline on sea area background | These colours are used to outline symbols depending on which background they are normally shown (water/land). |
| OUTLL | pale/dark brown | symbol outline on land area background |
| LITRD | red | red lights | Light symbols have their own colours to give the opportunity to influence their colour luminance individually. Yellow (LITYW) is used for white, yellow, orange and amber lights because it might be difficult to distinguish these colours from each other on a badly calibrated monitor. It also follows the tradition to show up white lights with a yellow flare or coloured arc. |
| LITGN | green | green lights |
| LITYW | yellow | white/yellow/orange/amber lights |
| ISDNG | magenta | isolated danger | Since the isolated danger symbol forms one of the most important items on the ECDIS screen, it is given a separate colour. |
| DNGHL | red | danger highlight | This colour is used for symbology that highlights Mariner selected dangers. The Mariner decides during route planning which features are highlighted by this colour. |
| TRFCD | magenta, dominant | traffic control features | Traffic separation schemes are complex chart features. The navigator is confronted with important elements of the schemes and with less important elements as well. TRFCD is used to distinguish important traffic routeing features. |
| TRFCF | magenta, faint | traffic control features |
| LANDA | brown | Land areas | This colour is used for land areas in general. |
| LANDF | brown | Landforms, land features | Landforms and land features are given a contrasting brown. |
| CSTLN | black/grey | Coastline, shoreline constructions | The coastline is a very important feature of the chart. If a radar image is combined with the chart picture it is required that coastline elements clearly show up on top of the green radar picture (see also RADHI/RADLO). To have full control over this combination under all conditions (day/night) a separate colour is reserved for coastline features. |
| SNDG1 | grey | deep soundings > safety depth | This colour is used for soundings that are deeper than the selected safety depth ("safe" soundings). |
| SNDG2 | black/white | shallow soundings <= safety depth |  |
| DEPSC | grey | safety contour | This colour is reserved for the selected safety contour. |
| DEPCN | grey | depth contours | All depth contours other than the safety contour should use this colour. |
| DEPDW | white/black | deeper than selected deep contour | These are depth shades. The depth zones are:   * DEPDW: areas deeper than the Mariner-selected deep contour; * DEPMD: areas between deep contour and the Mariner-selected safety contour; * DEPMS: areas between safety contour and the Mariner-selected shallow water contour; * DEPVS: areas between shallow water contour and the low water line (zero meter contour); * DEPIT: areas between zero meter contour and coastline (intertidal).   For route monitoring it may be desirable to distinguish only two water shades, plus DEPIT: deeper than own ship's safety contour and shallower than safety contour. In that case DEPDW and DEPVS should be used.  At night it may be difficult to distinguish between DEPMD and DEPDW. |
| DEPMD | pale/dark blue | safety contour to selected deep contour |
| DEPMS | light/medium blue | shallow contour to selected safety contour |
| DEPVS | medium/light blue | zero meter contour to shallow contour |
| DEPIT | yellow-green | high water line to zero meter contour |
| ***Radar image overlay colours*** | | | |
| RADHI | green | high intensity echo or single intensity echo | The radar image overlay can be generated by using either one intensity colour or a range of intensities. The colour for high echo intensity (RADHI) should be used where only one intensity is used. If you prefer to show more than one echo intensity or fading target trails, the corresponding colour intensities should be interpolated between the colour for high echo intensity (RADHI) and the colour for low echo intensity (RADLO).  Optionally, the manufacturer may vary the radar green overlay by making it transparent. |
| RADLO | green | low intensity echo & target trail |
| ARPAT | green, dashed | ARPA, target symbols & information | Used for ARPA targets and information tagged on them. |
| ***Mariners’ and navigation information colours*** | | | |
| SCLBR | orange | scalebar | Used to generate the scalebar. |
| CHCOR | orange | chart corrections | Hand entered chart corrections are marked by the colour. |
| NINFO | orange | Navigators Notes | Mariners' notes of any form (Symbols, Text) are generated using the colour. |
| ADINF | yellow | Mariners' transparent area fill and manufacturers' points and lines |  |
| ***Ships symbol and planned route*** | | | |
| SHIPS | black/white | own ship, Course & Speed Made Good vector |  |
| PSTRK | black/white | Past Track |  |
| SYTRK | grey | Secondary Track |  |
| PLRTE | red | planned route & notations |  |
| APLRT | orange | alternate planned route |  |
| ***Other colours*** | | | |
| RESBL | blue | AIS features and symbols |  |
| RESGR | grey | reserved for line features & screened areas |  |
| BKAJ1 | black | black level test symbol background |  |
| BKAJ2 | grey | black level test symbol foreground |  |
| TRNSP | 100% transparent | transparent | This means a 100% "transparent" colour. This is not a "real" colour since it is invisible. Every pixel on the screen, which has the colour value 0 shows up as 100% transparent. In case the pixel was already painted with another (visible, for example black) colour this colour is not overwritten by the transparent colour. In case the pixel was cleared before or not yet painted the "background" colour shows up (contrast to NODTA). |
| NODTA | grey | Areas without chart data | This colour shows up on every pixel on the screen, which is neither covered by chart features nor covered by other elements of the ECDIS display (for example radar overlay, user interface). Thus, it can also be called the "empty background colour" (contrast to TRNSP). |
| CURSR | orange | Cursor | In most graphic systems the cursor is treated as an item that can be handled completely independent from the graphic of the chart area. Therefore the cursor is given its own colour and it is kept separately from the other sections of the colour scheme. The cursor colour is also used by variable range marker (VRM), electronic bearing line (EBL), parallel indexing lines and other tools to perform absolute and relative measurements in the chart. |
|  |  |  | [To be added - significant colour tokens for other “important” data products, taken from the Product Specifications, if they are defined there.] |

Table C-27 - Significance of colour tokens for ECDIS displays

The active colour palette detemines the colour coordinates assigned to colour tokens in any particular display. Colour palettes for day, night, and dusk viewing conditions are required for S-101 and any other S-100 product intended for viewing on the navigation display.

# Cursor Pick Reports and Displays in Interface Panels

ECDIS must be capable of performing spatial queries on ENC and other data during import and symbolisation. Spatial query is understood as the ability to inspect graphical position and numerical value of spatial coordinates associated with a charted feature. Spatial query could be available as by means of cursor pick or as an independent function.

It should be possible to step forward or backward in spatial chains.

## Cursor pick rules

The rules below must be applied to all ECDIS cursor Pick Reports.

1. Full feature and attribute names should be displayed.
2. Spot selected on chart pane should be marked by symbols from IEC 62288.
3. Listed value names should be displayed.
4. There should not be any padding of attribute values, for example, a height of 10 metres should not be padded to 10.000000 metres as this could potentially confuse or mislead the Mariner.
5. Units of measure should be included after all attribute values which are weights or measures.
6. Cursor enquiry should extend to include both information associations and feature associations, including aggregations and compositions, which may link to information types or features that carry additional information such as a *featureName*.
7. Dates should be given in the form “Day Month Year” DD-MMM-YYYY.

Month abbreviations should be: JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC.

1. The Pick Report should only return information about the visible features on the ECDIS display. If the viewing group is turned on all features even “no symbol” features, those without visible presentation within that viewing group are available via the cursor Pick Report.
2. Cursor enquiry should extend to the uncertainty of the spatial object, including attributes *qualityOfHorizontalMeasurement*, *verticalUncertainty*, and *horizontalPositionUncertainty* from an associated **Spatial Quality** information type.
3. The Pick Report should indicate the data product from which the information is extracted. Descriptive data product names or abbreviations as should be preferred if possible (for example, “ENC” or “Electronic Navigational Chart”, not “S-101”). The Dataset Identification in the Product Specification and dataset discovery metadata in the Exchange Catalogue should contain this information.

Data from different products and viewing groups should be organized to facilitate navigation through complex reports in a manner logically consistent with the layering of products and groups on the screen.

## Pick Report descriptions

A plain language explanation of each symbol is included in the Portrayal Catalogue. This gives the Mariner quick and understandable information which is not always obvious from the feature class and attribute information. The manufacturer should always provide explanations to the Mariner in response to a cursor pick on the symbol.

Attribute values provided in addition to the above explanation should be connected to their meaning, and the definitions should also be available. The definitions are included in the XML Feature Catalogues for the data products.

### User defined cursor pick parameters

The Mariner should be able to configure the content displayed in the Pick Report.

## Visibility of feature attributes.

All Attributes and subattributes in feature catalogues have a visibility defined by the field S100\_FC\_AttributeVisiblity, with allowable values of public, private and protected visibility. Attributes with privateVisibility should not be shown to the user via the Pick Report. Attributes in the feature catalogue without a defined visibility or with other values have a public visibility and may be seen by the user in Pick Reports.

### Sorting order of results

The Pick Report must be organized to facilitate navigation through complex reports in a manner logically consistent with the layering presented on the screen.

The order of features must correspond to the drawing order. Features must be prioritized using the top-most drawing instruction associated with the feature. Only active drawing instructions which intersect the pick area should be evaluated during sorting.

Results must be sorted by display plane, then within each display plane by drawing priority. When the drawing priority is equal the geometric primitive must be used to order the information, points followed by lines and finally areas.

### Hover-over function

OEMs may wish to include hover-over functions for Mariners to access important charted feature details without having to select a Pick Report. If this function is implemented within an ECDIS, the Mariner should be able to configure the system to turn hover-over functionality on and off.

The hover-over function should only be used when indicated by a drawing instruction.

### Unknown attributes

When the ECDIS encounters an unknown attribute not present in the product’s Feature Catalogue its value must be available via the ECDIS cursor pick.

### Interoperability between datasets

The attribute interoperabilityIdentifier has been introduced to enable features within a dataset to refer to features contained within other datasets conforming to different product specifications. When a feature is being accessed via pick report, and it contains the attribute interoperabilityIdentifier, then any other features in the cursor query with the same value of interoperabilityIdentifier must also be included in the pick report details listed for the end user.

## Cursor queries on coverage data

Cursor queries on continuous gridded coverage data must report the coverage feature’s data values corresponding to the spatial location indicated by the cursor query. The data values reported should be those at the nearest data point for discrete coverages,.

For discrete coverages, the data point from which the result is reported should be highlighted. Highlighting grid data points is not required for continuous coverages.

Depictions of results may be customized by the product specification or manufacturer, provided important information in other parts of the display is not obscured. For example, time series information may be depicted using a graph.

See clauses C-13.1 and C-13.2 for more information on methods and rules for cursor queries on coverage features.

## Tidal stream data panels

Tidal stream information in the form of speed and direction at intervals relative to the time of a “reference tide” (generally high or low water) should be formatted for display in the ECDIS cursor Pick Report (or other UI panel). Table C-28 shows the template that should be used for displaying the values The table layout may be modified depending on the modeling – for example, the "Rates” column may be split if both springs and neaps rates are both provided for the same direction instance, or values for different reference tides may be provided in different tabs; however, the reference tide type must be shown. The “Hours” values should be the actual values in the *timeRelativeToTide* attribute.

|  |  |  |  |
| --- | --- | --- | --- |
| Tidal Station: (*station name*) | | | |
| Tidal Station Identifier: (*station identifier*) | | Data From: (*data product, from dataset metadata*) | |
|  | Hours | Direction of stream (degrees) | Rates (knots) |
| springs |
| Before | -6 |  |  |
| -5 |  |  |
| -4 |  |  |
| -3 |  |  |
| -2 |  |  |
| -1 |  |  |
| (*reference tide*) | 0 |  |  |
| After | +1 |  |  |
| +2 |  |  |
| +3 |  |  |
| +4 |  |  |
| +5 |  |  |
| +6 |  |  |

Table C-28 - Template for tidal stream values

Table C-29 below relates an exemplary **Tidal Stream Panel Data** feature and its attributes to its display.. Complex attributes are in italics and encoded values are in blue text.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tide Stream Panel Data (feature)** | | | | **Example of ECDIS depiction** |
| Station name | | PLYMOUTH (DEVONPORT) | | (If values for neaps are provided in a separate *tidal stream panel* complex attribute in the same feature, a similar table for neaps must be provided in the UI.) |
| Station number | | 0014 | |
| *Tide stream panel values* | | | |
| Reference tide | high water | | |
| Reference tide type | springs | | |
| *Tide stream value* | *Orientation* | Orientation Value | 113 |
| Time relative to tide | | -6 |
| speed maximum | | 0.1 |
| *Tide stream value* | *Orientation* | Orientation Value | 332 |
| Time relative to tide | | -5 |
| speed maximum | | 0.6 |
| *Tide stream value* | *Orientation* | Orientation Value | 331 |
| Time relative to tide | | -4 |
| speed maximum | | 1.1 |
| *Tide stream value* | *Orientation* | Orientation Value | 342 |
| Time relative to tide | | -3 |
| speed maximum | | 1.0 |
| *Tide stream value* | *Orientation* | Orientation Value | 347 |
| Time relative to tide | | -2 |
| speed maximum | | 0.7 |
| *Tide stream value* | *Orientation* | Orientation Value | 333 |
| Time relative to tide | | -1 |
| speed maximum | | 0.5 |
| *Tide stream value* | *Orientation* | Orientation Value | 317 |
| Time relative to tide | | 0 |
| speed maximum | | 0.3 |
| *Tide stream value* | *Orientation* | Orientation Value | 178 |
| Time relative to tide | | 1 |
| speed maximum | | 0.3 |
| *Tide stream value* | *Orientation* | Orientation Value | 146 |
| Time relative to tide | | 2 |
| speed maximum | | 0.6 |
| *Tide stream value* | *Orientation* | Orientation Value | 140 |
| Time relative to tide | | 3 |
| speed maximum | | 1.0 |
| *Tide stream value* | *Orientation* | Orientation Value | 143 |
| Time relative to tide | | 4 |
| speed maximum | | 1.1 |
| *Tide stream value* | *Orientation* | Orientation Value | 143 |
| Time relative to tide | | 5 |
| speed maximum | | 0.8 |
| *Tide stream value* | *Orientation* | Orientation Value | 138 |
| Time relative to tide | | 6 |
| speed maximum | | 0.3 |

Table C-29 - Example of tidal stream panel data and its ECDIS display

## ~~Schedules, contact Information, and vessel characteristics~~

[Templates to be developed.]

## ~~Special Pick Report formats~~

Some Product Specifications may require or suggest specific layout and contents for Pick Reports (examples are shown in Figure C-8). Since there is at present no generic format for defining such custom Pick Reports, manufacturers will need to develop their own solutions.

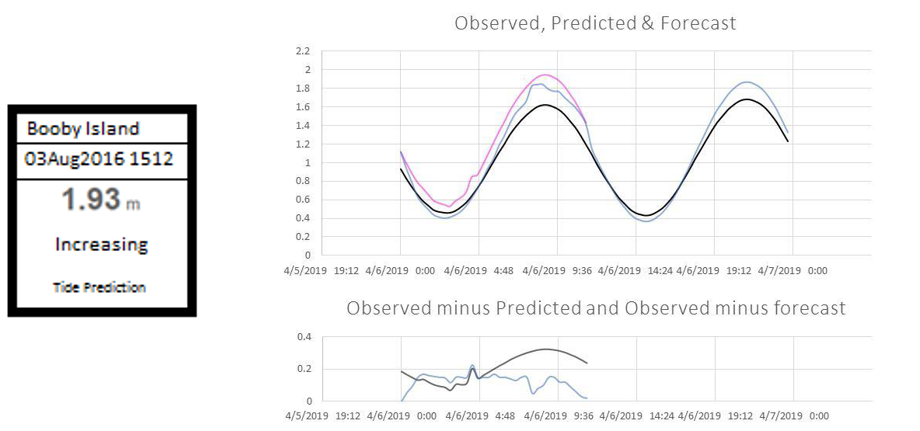


Figure C-8 - Examples of special formats: Water level at a station (L) and graphic showing time series of water level data (R)

## ~~DELETED~~ (duplicate)

# Alerts and Indications

IMO Resolution MSC.530(106) states in 11.3 and 11.4 and their sub-paragraphs how an ECDIS should respond to risk of crossing, dangers, prohibited areas or areas with special conditions, during route planning (11.3) or route monitoring (11.4). Appendix 4 and Appendix 5 of the same resolution provide details about the areas for which an ECDIS should detect incursions and provide an alert or indication.

All Product Specifications which are intended for navigation should specify any feature combinations that match one or more of the areas for which alarm or indication should be given to ensure there is a harmonized implementation of alerts and indications in navigational products. Such specification could be done using a machine-readable Alerts and Indication Catalogue.

# Use of Context Parameters

The Portrayal Register in the IHO GI Registry contains a list of predefined context parameters used in S-100 Portrayal Catalogues. Manufacturers may add additional parameters, but should not change the names, roles, or data types or predefined parameters, or substitute other parameters of the same scope.

The Portrayal Catalogue for a product contains the set of known parameters which may be used in the portrayal processing for that product. This set may be different for different products[[4]](#footnote-9). Context parameters are used for passing portrayal-related configuration information and user settings to portrayal processing, and the values of context parameters may therefore be changed by user functions, including those defined in the IMO Performance Standards, in this document, or manufacturers’ custom user functions.

In order to be able to use the official Portrayal Catalogue for a data product, manufacturers must implement all the context parameters listed in the Portrayal Catalogue. The context parameters used in a Portrayal Catalogue are listed in the **<context>…</context>** section of the Portrayal Catalogue XML file.

Context parameters may be added or removed by updates to the Portrayal Catalogue. Context parameters which cannot be automatically associated with ECDIS display functions or user interface features must be exposed to the Mariner for use.

## Context parameters for ECDIS functionality

Context parameters are used in Portrayal Catalogues for implementing mandatory and optional ECDIS functionality mandated by the IMO Performance Standards. Since they are used by rules in the IHO Portrayal Catalogue, they should be implemented without change by manufacturers in order to maintain compatibility with the IHO Portrayal Catalogue.

# Dual-fuel systems

Dual-fuel systems are systems that use both older (pre-S-100) and newer (S-100) data products that contain the same type of information (for example, S-57 and S-101 ENCs).

All stakeholders should anticipate a transition period during which new S-100 formats increasingly replace older formats.

An S-100 ECDIS must be able to handle both S-57 and S-101 ENCs during the transition period.

## Display of data available in both new and legacy formats

The question of handling simultaneous display of data in old and new formats is still to be addressed by the IHO at the time this document is being written.

## Display of additional information layers

The display of additional information layers is generally driven by mariner need. The Interoperability Catalogue concept for ECDIS (see S-100 Part 16 and S-98) is based on using S-101 ENCs as the base layer. Therefore, in areas without S-101 ENC data, manufacturers and data producers should expect additional information layers to be displayed as overlays over S-57 ENC data.

The converse is also allowed - data in legacy formats may be displayed as overlays over S-101 data.

In both cases, the applicable requirements in the IMO Performance Standards must still be met, especially requirements about not degrading the route monitoring display.

## Concurrent applicability of S-52 and S-57

Dual-fuel capable systems should continue to use the principles defined in S-57 and S-52 for the presentation of chart data that conforms to S-57 instead of S-101. The principles in S-101 and this Annex should be concurrently applied where S-101 data is displayed. This includes the case where one part of the chart window has S-101 data as the chart layer and another has S-57 data as the chart layer - S57/S-52 apply to the portion where S-57 data is the chart layer and S-101 and this Annex apply where S-101 data is the chart layer.

Overlays of S-100-based non-ENC data over S-57 chart data are left to manufacturer discretion, pending development of guidance by the IHO. Where S-100-based non-ENC datasets are overlaid over S-57 data, they should be treated as “additional information” in the sense of IMO MSC.530(106), including the requirement to avoid degrading the display of ENC information. Activation of the new functionalities described in this Annex for screen regions where S-100 data is overlaid over S-57 ENCs is left to manufacturer discretion, pending the development of guidance by the IHO. For example, S-98 interoperability need not be implemented in the absence of an S-101 base layer, but graphical indexes can still be displayed for non-ENC S-100 products and thinning for an S-111 (Surface Currents) grid can still be applied even if it overlays S-57 data.

MSC.530(106) and other applicable IMO standards continue to apply to the “S-57 portion” of the display, and, in the absence of updated IMO standards specifically for S-100-based data, also to the “S-101 portion” of the display. The IEC standards should continue to be used for testing, with necessary extensions to test for the “S-101 portion” of the display, pending IEC update of the IEC standards for S-100-based displays and this Annex.

This Annex is designed to allow such integrated displays. Note in particular:

* The IMO functions continue to be used. This Annex describes their applicability to S-100-based data and defines additional functions for S-100-based data. Any additional functions that apply only to S-100-data should be deactivated for S-57 data.
* The IMO display categories and viewing groups for S-57 data are carried over into this Annex and include the same feature information for each group as in S-52.
* Where S-101 changed S-57 modelling, the replacement features have been assigned to the same viewing group as before.
* Features that are wholly new in S-101 compared to S-57 are assigned to new viewing groups.
* Features from new non-S-101 data products are assigned to new viewing groups.
* The principles for chart furniture and miscellaneous display elements (scale boundaries, limits of data, safety contour, depth zones, update identification, legend, etc) are the same in S-52 and this Annex.
* Additional functionalities such as graphical indexes, data quality indication, etc, are independent of the legacy/modernised nature of the information. To minimise clutter and maximise compatibility with legacy data, the functionalities for modernised data are defined so they can act on/with only ENC data in the first place, and on/with other S-100-based data only upon additional or different operator action. For example, the graphical indexes requirement (clause C-12.2) is separated into sub-requirements, one for ENCs and the other for other S-100-based products.
* The names of colour tokens are the same. (Future versions of this Annex may add additional colour tokens, but should retain the S-52 set.)

Note that some things required for complete compatibility of S-57/S-52 and S-101 presentations cannot be controlled in this Annex, depending as they do on the harmonisation of Portrayal Catalogues with S-52 symbology, colour tables, and lookup tables. Among these are the shapes and dimensions of symbols and the colour coordinates assigned to colour tokens.

# Type approval considerations

Manufacturers, type-approval authorities, and above all Mariners, are always encouraged to contact the IHO over any improvements, criticisms, questions or comments that they may have about the ECDIS display, in order that the Specifications can be kept effective and up to date.

# Specifications for the display screen

## Physical display requirements

The requirements for the main graphic display are:

Size: Minimum effective size of the area for chart display: 270 x 270 mm (IMO MSC 530(106) 10.2).

Resolution: Minimum lines per mm (L) given by L=864/s, where s is the smaller dimension of the chart display area. (e.g. for the minimum chart area, s=270 mm, the resolution L = 864/270 = 3.20 lines per mm, giving a "picture unit" size of 0.312 mm)

Colours: 64

The specifications above permit a chart display whose minimum resolution (lines/mm) may vary depending on the size of the display. Maintaining a clearly readable chart display under this flexibility imposes certain requirements on the display software, which are described in clause C-10.2.

Information should be displayed in the ECDIS on one or more physical screens, which may be divided into more than one chart display. Information may be displayed automatically, on demand or as a result of Mariner's selection.

The physical size of the screen(s) should be appropriate to viewing conditions. Larger screens may be more suitable for situations where the operational viewing distance is higher, because the larger physical area of the display offsets the reduction of on-screen geographical extent that is caused by the greater zoom levels and symbol sizes necessitated by greater viewing distances.

Redraw during route monitoring to follow the ship's progress, including scale changes due to change in the scale of the chart information, should take less than 5 seconds. Demands by the Mariner that cannot be predicted by the ECDIS, such as draw at a different scale or in a different area may take more than 5 seconds. In the latter case:

* The Mariner should be informed;
* The display should continue route monitoring until the new information is ready to draw within 5 seconds.

## Colour reproduction

Absolute accuracy in colour reproduction is not required but relative colour fidelity is important. To ensure clear contrast between colour-coded features the display screen should be calibrated before use, and this calibration should as far as possible be maintained while in service. If this is not done, lines, symbols, and area shades may become indistinct, and information may then be lost or become misleading.

## Display requirements for colours

*~~[Content is from the following sections of S-52 6.1.1:~~*

*~~4.1 General~~*

*~~4.2 Colour Assignment: Content directly under this S-52 heading is now in clause C-16.2 (Selection of colours (informative) and will not be repeated here.]~~*

*~~4.2.2 Bright Sunlight or Night viewing - Use of filters, etc.~~*

*~~4.2.3 Display calibration and verification.~~*

*~~4.2.4 Colour control; contrast and brightness controls.~~*

*~~4.2.4.1 Effect of controls.~~*

*~~4.2.4.2. Use of the controls.~~*

*~~4.2.4.3. Initial setting of the controls.~~*

*~~4.2.4.4. Re-adjustment of the controls.~~*

*~~4.2.4.5. Setting the controls for route monitoring.~~*

*~~Section 4.2.6 (The colour scheme - colour tokens) has been rewritten as “C-14.2” and section 4.2.7 (Transparency) is included as “C-14.4 Transparency” and those sections will not be repeated here.]~~*

### General

The ECDIS manufacturer can use any technology to build the display as long as their display fulfils the requirements of this Specification.

### Bright sunlight or night viewing - use of filters, etc

The information-carrying capability of the ECDIS display is curtailed at the extremes of bright sunlight and night viewing. The reasons, and some remedies, are described in this section.

**Bright sun**. Some of the strong ambient light on the bridge is reflected off the back of the display screen face plate and arrives at the Mariner's eye mixed with the light generated by the monitor which carries the image of the ECDIS display. This display image is further diluted by light entering the Mariner's eye directly from the brightly-lit bridge. The effect is to make the display look washed out; contrast between features may be severely reduced. In the extreme case of sunlight shining directly on the screen, no information at all will be visible. In addition, reflections on the face of the monitor from objects close to the screen, particularly a Mariner's white shirt, may mask parts of the display.

The ECDIS display should be situated where direct sunlight will not shine onto it, nor into the eyes of the mariner looking at it. A visor around the face of the screen may help. A filter may also help, (because it attenuates the sunlight twice, both when incident and when reflected, whereas the monitor image is attenuated only once). Low attenuation neutral density filters may be used, such as a 2 times attenuation filter designated (logarithmically) "0.3 ND". Polarised filters should be an advantage. Ideally, the bridge windows should have glare reducing glass and the inside of the bridge should have non-reflecting paint.

**Night**. The need to preserve night vision requires that the illumination from the screen be reduced to a lower level than is desirable from considerations of clear viewing. The light level from night colour tables is below that which provides full contrast capability. Consequently some area-fill colours are indistinguishable on the night display, as noted in S-52 Edition 6.1.1 section 3.2.2 (2), and colours of lines may be difficult to distinguish.

An additional problem for a CRT type of monitor is that the R,G & B guns of the CRT may drop to the cut-off point at these very low DAC (digital to analog converter) voltages, particularly on an ageing CRT. Because good quality neutral filters reduce illumination without significantly affecting colour, and even tend to enhance contrast their use is recommended for the night display.

### Display calibration and verification

The ECDIS display should be calibrated initially in order to transform the CIE colour table coordinates to screen coordinates. The main components of the ECDIS display are the monitor and the image generator. Both the monitor and the image generator used to drive the ECDIS display can be calibrated together as a colour generating unit. Another alternative is to calibrate separately both the monitor and image generator.

The following international standards describe methods for calibration of a monitor’s RGB values to produce an output. Other methodologies may be followed, but the same verification test requirements apply regardless of method.

CIE 122-1996 *Technical Report: The Relationship between Digital and Colorimetric Data for Computer-Controlled CRT Displays.*

IEC 61966-3:2000 *Multimedia systems and equipment -Colour measurement and management - Part 3: Equipment using cathode ray tubes*, Edition 1.

IEC 61966-4:2000 *Multimedia systems and equipment-Colour measurement and management – Part 4: Equipment using liquid crystal display panels*, Edition 1.

The ECDIS display calibration should be verified for type approval of all monitors. Colour control, contrast and brightness controls

There are a variety of technologies available for monitors to be used for ECDIS display. Different technologies have different methods to control colour, contrast and brightness, but some basic rules apply for all of them.

#### Effect of controls.

The contrast control of a display generally shortens or extends the range of luminance available, making the display appear darker or brighter.

On the other hand, the brightness control shortens or extends the range of colour saturation available by adding white (which extends the range by making colours other than black less saturated), or subtracting white (colours become darker, more saturated.)

To the viewer, it has much the same apparent effect as contrast, but it achieves this by altering the colour contrast of the colour tables between foreground and background colours, and this may result in some features becoming harder to see, particularly at night. More importantly, making the night display more saturated may drop some dark colours below the cut-off point, into black, thus losing distinctions such as shallow versus deep water.

#### Use of the controls.

Colour tables are provided for day, dusk and night. The mariner should be provided with the control to make fine adjustments between these tables; the calibration position should be marked as a reference for this.

For a CRT type of monitor the brightness control should be pre-set; that is, used only when essential, with provision to return to the calibrated setting. LCD and other monitor technologies have a variety of controls. The general principle is that all available controls should have a provision to return to the calibrated settings and that only appropriate controls should be made available for the Mariner.

The ECDIS manual should carry a warning that careless use of the display controls may adversely affect the visibility of information on the display.

#### Initial setting of the controls.

The controls should be set up in preparation for initial calibration, and their positions marked at that time (for example, by a detent) so that they are recoverable.

#### Re-adjustment of the controls.

In case the controls go out of adjustment in use, they may be re-adjusted on-board ship by means of the Colour Differentiation Test Diagram described in clause C-20.5 and provided by the IHO.

#### Setting the controls for route monitoring

The ECDIS display carries far more detail than a radar display, and requires correspondingly more attention to the correct selection of colour table and the correct adjustment of the controls.

This particularly affects the black-background displays, and is critically important at night, because all colours of the night table, particularly those for large areas, have to be set very dark to avoid loss of night vision, and if the control is turned down too far these colours will disappear into the black background. As a result, chart information will be lost.

The situation will be worse if one of the day tables is improperly dimmed for use at night, instead of switching to the night table.

It is important that the display be adapted to lighting conditions on the bridge by selecting the correct colour table: "Day" for bright sunlight; "Day” or "Dusk" for general daylight viewing; "Dusk" for twilight; and "Night" for the night-darkened bridge.

The controls should only be used for fine adjustment within the appropriate colour table.

To ensure that the controls are always set to a level above that at which information will be lost, the black-adjust symbol BLKADJ should be available to the Mariner, treated as "Standard display", to be called up at any convenient point on the screen. The instructions for its use by the Mariner should be incorporated in the "Users instructions" for the ECDIS.

Below is an example of instructions for a CRT type of Monitor:

1. First, set contrast to a maximum, brightness to a minimum. Look at the black-adjust symbol. Then either:

2A. If the centre square is not visible, turn up the brightness until it just appears;

or

2B. If the centre square is clearly visible (with contrast at maximum, brightness at minimum), turn the contrast down until the inner square disappears, then turn contrast back up until the inner square is just visible again.

(If the above adjustment is not successful, select a more appropriate colour table and repeat this procedure.)

The "black level" is now correctly set. If a brighter display is required use the contrast control, but it is better not to re-adjust the controls unless lighting conditions on the bridge change.

Note that the black-adjust symbol should be displayed to check that the inner square remains visible on the following occasions:

* Every time that the brightness or contrast controls are adjusted.
* Every time that the display is switched to the night colour table.

Below is an example of instruction for LCD type of Monitor. The LCD type of monitor used in this example has only one mariner control, which is called brilliance. Internally the monitor has also other controls available for service engineers. These internal controls include also controls named as contrast and brightness.

1. First, set brilliance to calibration position. Look at the black-adjust symbol.

Then either:

2A. If the centre square is not visible, turn up the brilliance until it just appears;

or

2B. If the centre square is clearly visible, turn down the brilliance until the inner square disappears, then turn brilliance back up until the inner square is just visible again.

(If the above adjustment is not successful, select a more appropriate colour table and repeat this procedure.)

The "black level" is now correctly set. If a brighter display is required use the brilliance control, but it is better not to re-adjust the controls unless lighting conditions on the bridge change.

Note that the black-adjust symbol should be displayed to check that the inner square remains visible on the following occasions:

* + Every time that the brightness or contrast controls are adjusted.
  + Every time that the display is switched to the night colour table.

It is recommended that the BLKADJ symbol be displayed automatically all the time that the night colour table is selected, with a Mariner over-ride to remove it if necessary.

## Colour display capability

Colour displays should be capable of at least 256 luminance steps in each of red, green and blue.

For night performance it is essential that the hardware has a graphics card capable of giving "blacker than black"; that is, complete control of colour, and that the software can control that function.

For CRT type of monitor cathode (beam) current stabilisation is desirable, to prevent dark colours dropping below the cut-off point.

### Colour conversion tolerances and tests

#### Tolerances

The tolerances quoted below apply only to the process of converting CIE colour coordinates to RGB values, and so should be evaluated shortly after the ECDIS leaves the manufacturer's plant.

Considerable operational experience will be needed before it will be possible to state colour maintenance tolerances for ECDIS on-board ship.

The colour tables developed have been selected to ensure maximum colour discrimination between features. Colour discrimination depends on both the colour difference and the luminance difference between two colours. Colour science (as represented by the CIE colour convention) has defined colour difference units ΔE\*. The ΔE\* metric is a measure of the overall discrimination (including both colour and luminance differences). As a metric for ECDIS colour accuracy, a measure of the discrimination in colour alone, excluding luminance differences has been defined as a subset of ΔE\* referred to as Δ(u\*,v\*).

Δ(u\*,v\*) = SQRT [ (u2\*-u1\*)2 + (v2\*-v1\*)2 ]

ΔE\* = SQRT [ (L2\*-L1\*)2 + (u2\*-u1\*)2 + (v2\*-v1\*)2]

Calculations of L\*, u\*, and v\* must be made using as reference the chromaticity and luminance specified for the brightest white colour token in the respective colour table (Y0, u0, y0); where Y0 is the luminance in units of cd/m2. Note: this is not the brightest white of the monitor.

Note: “Δ” represents the Greek letter “Delta”, although it may appear differently on some computers.

The tolerances for the conversion of the colour tables from the CIE colours defined in these specifications to the actual RGB values for the ECDIS CRT are defined in three terms:

1. Overall discrimination between actual colours within the converted table: ΔE\*. This is to ensure that all the colours within the RGB table remain discriminably separate; that is, that the relative colour distinctions have been maintained.

2. Colour discrimination differences between the defined and the actual values: Δ(u\*,v\*). This is to ensure that the actual RGB colours resulting from the conversion remain reasonably close to the CIE colours defined in the specifications; that is, that the blues stay blue and the greens stay green.

3. Luminance differences between the defined values and the actual values: L. This is to ensure that the luminance remains the same within acceptable limits.

Note: The CIE L\*u\*v\* human perception colour model, which is the source of the tolerances described above, has not yet been evaluated at the low luminances of the night colour table, at which the less colour-sensitive rods of the eye take over from the daytime cones. Consequently these tolerances should not be applied to the night table; and for type-approval purposes they are restricted to the bright sun table.

Colour tolerance values:

1. The discrimination difference between any two colours displayed (except those with a tabular ΔE\* less than 20) should be not less than 10 ΔE\* units.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Token** | **Colour (x, y, L)** | **Token** | **Colour (x, y, L)** | **ΔE\*** |
| DEPMD | (.27 .30 65)  pale blue | CHWHT  DEPDW  UIBCK | (.28 .31 80)  white | 11 |
| CHBRN | (.42 .45 30)  brown | ADINF | (.41, .47 35)  yellow | 14 |
| DEPMS | (.24 .26 55)  medium blue | DEPVS  UIAFD | (.22 .24 45)  medium blue | 17 |
| DEPMD | (.27 .30 65)  pale blue | CHGRF  NODTA  (S-52 Ed 3.3 colours have greater ΔE) | (.28 .31 45)  faint grey | 18 |

Table C-30 - Tolerance exceptions

2. The difference between the colour displayed and the CIE colour defined in these specifications should be not greater than 16 Δ(u\*,v\*) units. If a monitor is independently tested, then the difference must not be greater than 8 Δ(u\*,v\*) units.

3. The luminance of the colour displayed should be within 20% of its specified value. Black is a special case and the luminance of it must not be greater than 0.52 cd/m² for bright sun colour table.

#### Instrumental calibration verification test

For CRT displays, an instrumental test to check that the results of the colour conversion calibration are within tolerance should be made by displaying the colours of the Day colour table (restricted to colour pairs of tabular ΔE\* greater than 20); measuring their CIE coordinates x,y and L; and applying a tolerance test. For LCD displays the instrumental test should be applied to all three colour tables.

Note that since the tolerance test is intended solely to check successful colour calibration, and not to test colour maintenance at sea, this test should be performed on the bench in the manufacturer's or type-approval authority's plant under normal conditions of temperature, humidity and vibration.

Manufacturers of ECDIS can choose between two different methods of colour calibration.

The first method is a test of a monitor as part of an integrated system. In this method both the monitor and the image generator parts of ECDIS display are tested together.

The second method is an independent test of the monitor. In this method the monitor and the image generator of ECDIS display are separately tested against a reference (that is, the monitor is tested against a reference image generator and the image generator is tested against a reference monitor). The second method has tighter tolerance for displayed colour than the first method (see clause C-20.4.1.1).

## Colour differentiation test diagram

A multi-purpose colour differentiation test diagram is illustrated in Figure C-9. This consists of 20 squares each coloured with one of the 4 main background colour fills (such as shallow water blue); and each having a diagonal line in one of the six important foreground colours (such as mariner's orange). Each diagonal line is 0.64mm.

The diagram is in the form of a dataset and so can be displayed using any of the three colour palettes. This diagram is intended:

1. For use by the Mariner to check and if necessary re-adjust the controls, particularly for use at night;
2. For use by the Mariner to verify that an ageing display remains capable of providing the necessary colour differentiation; and
3. For initial colour verification of the day, dusk and night colour tables.

Both the Colour Test Diagram and the instructions for its use (see clause C-20.7) should be made available to the Mariner.

In addition, a grey scale is described in clause C-20.7 for use by maintenance technicians in checking colour tracking in an ageing display.

The Colour Differentiation Test diagram is intended for use off-line. It is not needed during route monitoring.

Note that the Colour Differentiation Test Diagram will not be true to colour unless it is projected on a calibrated screen and is generated using the digital format provided by IHO, which correctly reproduces the colour tokens of the Presentation Library.

The colour differentiation diagram is required in "Day" and "Dusk" colours so that the Mariner can verify that the ECDIS display monitor has the colour differentiation capability needed to distinguish between the various colour-coded areas, lines and point symbols of the ECDIS display. Both diagrams will be provided online by the IHO and should be downloaded by manufacturers for supply with ECDIS software. The diagrams will not be true to colour unless they are projected on a calibrated monitor and are generated in a manner which correctly reproduces the colour tokens.

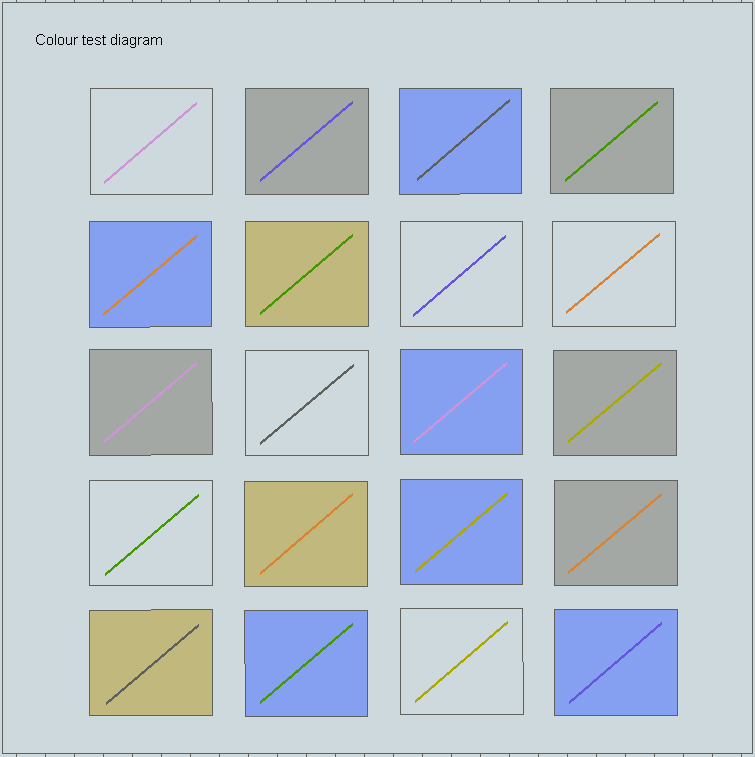


Figure C-9 - Colour differentiation diagram - Day

[NOTE: For illustrative purposes only. The diagrams from the IHO web site should be downloaded for testing.]

## ECDIS Chart 1

The IHO provides ECDIS Chart 1 in digital form, a graphical index of ECDIS symbols including both simplified and paper-chart point symbols; and also the symbolized lines and area boundary linestyles. This is intended to familiarize the Mariner with the colour and symbol coding used by the ECDIS. The symbols are grouped according to INT1, which is familiar to the Mariner, but are numbered with a look-up sheet, not labelled. Manufacturers should provide linking by cursor interrogation between the symbols and the explanations given in ECDIS Chart 1.

Since Product Specifications for data products used on ECDIS will be updated at different times, there may be a supplementary “Chart 1” for each data product other than ENC that is intended for use in ECDIS.

The ECDIS Chart 1 and any supplements are intended for use off-line and in route planning. They are not needed during route monitoring, when the Mariner can use cursor enquiry to find the meaning of symbols.

The ECDIS Chart 1 and its indexing list of symbol names and meanings arranged numerically, together with the colour differentiation test diagrams, are intended for the Mariner’s use. The use of the Colour Differentiation Test Diagrams is described in C-20.5. A separate plot of symbols arranged alphabetically and an indexing list of symbol names and meanings arranged alphabetically will be provided for the manufacturer’s use.

Note that because colour printing and copying is not completely true to the original, a hard-copy version of Chart 1 does not accurately represent the colour requirements of the IHO Colour and Symbol Specifications.

In addition, symbol size may change in copying. To ensure correct size, all symbols illustrated must be scaled by the factor required to make symbol CHKSYM01 measure 5mm by 5mm.

## Use of ECDIS Chart 1 and Colour Test Diagram

### Specification for ECDIS Chart 1 and the Colour Test Diagram

#### Definition (for this specification only)

A Chart 1 dataset must be displayed so as to fill all of the standard ECDIS display area (that is, the minimum 270 x 270 mm chart area).

#### Description and purpose

The ECDIS Chart 1 and the Colour Differentiation Test are diagrams for use by the Mariner which are provided in the form of a number of ENC datasets.

The ECDIS chart 1 is intended to familiarise the Mariner with the symbology used on ECDIS. The Mariner must be able to display each cell, and by cursor-pick get a read-out of the meaning of any feature shown.

The Colour Differentiation Test diagram is intended for display using the day or dusk colour tables so that the Mariner can check that the ECDIS display is providing adequate colour performance. It is also used in type-approval testing. Instructions for its use are given in the sections below.

The ECDIS Chart 1 includes the CHKSYM symbol which is intended for checking the correct size of the symbols during the type approval. The width and height of the CHKSYM is 5.0 mm.

The line width of the diagonal lines in the Colour Differentiation Test diagram is specified as 0.6 mm wide..

#### Mode of use

These diagrams are supplementary features of the ECDIS, intended for use off-line or during route planning. Because they occupy the entire display they must not be used during route monitoring. If the Mariner needs to find the meaning of a symbol during route monitoring, they must use cursor-picking.

The operation of these diagrams is not subject to the draw-speed requirements of route monitoring.

#### Content and Encoding

Chart 1 is released as a number of S-101 datasets within the S-164 suite of test data. Portrayal and content are defined wholly by the S-101 feature and portrayal catalogues.

#### Revisions

Revisions will be made by whole file replacement; that is, by issuing a new edition.

#### Packaging

The data files may be downloaded from the IHO web site.

#### Presentation and parameter settings

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### Displaying the Colour Test Diagram

#### Introduction; providing the diagram

The Colour Differentiation Test diagram is provided to enable the Mariner to verify that the display screen still retains the colour differentiation capability needed to distinguish between the various colour-coded areas, lines and point symbols of the ECDIS display.

The diagram will not be true to colour unless it is displayed on a calibrated monitor and is generated using the provided ENC portrayal catalogue.

The two methods of providing the diagram are:

1. Use the dataset labelled “101AA005C1WOO” containing the Colour Differentiation Test Diagram. This file must be drawn so that the extent of the imaginary chart data covers the entire ECDIS display. Because the file uses customised features and attributes, it must be displayed using the special Portrayal and Feature Catalogues provided for the digital S-100 ECDIS Chart 1.
2. ~~Use the graphics file illustrated in Figure C-9 as a model. Based on this model, reproduce the same pattern of rectangles and lines on the screen, but present them in the correct colours using the colour tokens given in the S-101 colour profiles provided by the IHO.~~

The diagram consists of twenty numbered squares extending over the whole of a 270 x 270 mm screen. Each square is coloured with one of the four main background area shades (such as shallow water blue, DEPVS), and each carries a two-pixel wide diagonal line in one of the important line or symbol foreground colours (such as planned route red, PLRTE). These are arranged as follows:

**Four main background colours:**

DEPVS (shallow water blue) squares 3, 5, 11, 15, 18, 20.

DEPDW (deep water, white or black) squares 1, 7, 8, 10, 13, 19.

LANDA (land colour) squares 6, 14, 17.

NODTA (no data shade: radar, navigation safety squares 2, 4, 9, 12, 16.

lines and chartwork must be visible on the

no-data part of a display)

**Six important foreground colours:**

DEPSC (safety contour grey) squares 3, 10, 17.

NINFO (orange, Mariner's information) squares 5, 8, 14, 16.

ADINF (yellow, manufacturer's information) squares 12, 15, 19.

TRFCD (magenta, traffic lanes and area boundaries) squares 1, 9, 11.

RADLO (the lower luminance radar green) squares 4, 6, 13, 18.

RESBL (blue, provisionally reserved for traffic info squares 2, 7, 20.

from transponder, VTS etc.)

~~Note: Remember that a TIFF, PDF or other source will not be true to colour unless it has been specifically modified to access the colour tokens and colour tables used by the ECDIS.~~

#### Test description

The dusk and night tables should be checked subjectively by means of the colour differentiation test diagram, which is provided as an S-101 file (.tif file diagrams must not be used for this purpose), as follows:

(1) The person carrying out the test should have passed the Isihara colour blindness test, or other test used to qualify bridge watch keepers, and should adapt to night viewing for 10 minutes before checking the night display;

(2) The controls should be set to their calibrated settings;

(3) While the display is off, adjust the ambient light reflected from white paper positioned on the display screen to the following values:

Colour profile Light level

Day 200 cd/sq. m

Dusk 10 cd/sq. m

Night darkness (the ECDIS display is the predominant light source)

Preferably use natural daylight for the day table;

(4) Under each of the above conditions, display the appropriate colour differentiation test diagram for the colour profiles.

Select each table in turn and ensure that:

* Each foreground diagonal line is clearly distinguished from its background; and
* The foreground lines representing yellow, orange, magenta (purple), green, blue and grey may be clearly identified.

#### Relationship to S-57 Chart 1

The Chart 1 datasets are located alongside the existing S-57 Chart 1 cells.

#### Using the diagram

The Colour Test must be applied on the day and dusk colour tables.

Before the Colour Test diagram is used, the black-adjust symbol BLKADJ01 must be brought up on the screen and the contrast and brightness controls (or equivalent controls for an LCD) must be adjusted as follows:

1. First, set contrast to a maximum, brightness to a minimum. Look at the black-adjust symbol. Then either:

2A. If the centre square is not visible, turn up the brightness until it just appears;

or

2B. If the centre square is clearly visible (with contrast at maximum, brightness at minimum), turn the contrast down until the inner square disappears, then turn contrast back up until the inner square is just visible again.

(If the above adjustment is not successful, select a more appropriate colour table and repeat this procedure).

The "black level" is then correctly set. If a brighter display is required use the contrast control, but preferably do not adjust the controls unless lighting conditions on the bridge change.

The test consists of being able to distinguish the background colours and to pick out the like foreground colours, that is to say that squares 3, 5, 11, 15, 18 and 20 all have a shallow water blue background, and that squares 3, 10 and 17 have a grey line.

Note: The test above uses the black-adjust symbol for the purpose of a type approval test. The other purpose of the black-adjust symbol BLKADJ01 is to allow the Mariner to adjust the display for ambient illumination on the bridge of a ship. An ECDIS must have the black-adjust symbol displayed whenever the mariner is adjusting the display (that is, depending on the technology of the display brilliance, brightness, contrast, etc), as required by clause C-20.3.

### Grey Scale

A grey scale may be used by service technicians to detect display ageing or other display performance issues.

Eight grey strips are recommended, spaced between the minimum and the maximum luminance for each of the five mandatory colour tables.

The bit levels or signal levels producing the grey levels are evenly spaced from the level producing white to the level producing black. In order to select the appropriate grey level from a large set of available grey levels, use one of the following models:

1. Bit Levels in Software: Given n levels of grey that can be displayed on a screen, with 0 for black and w = n - 1 for white. We want to select a subset of m levels that are as evenly spaced as possible. The interval between the n levels to create m levels is ΔV = w/(m-1), which may not be an integer. So, the levels to select are the (integer) values of Vi= int[(i-1) ΔV] for i = 1, 2, ..., m, or Vi= 0, int(ΔV), int(2ΔV), int(3ΔV), ..., int[(m-1) ΔV], with int[(m-1) ΔV] = w for white. For example, if there are n = 256 = 28 levels from which we select m = 8 levels, white is w = 255; the interval is ΔV = 36.4286, and the chosen levels are: 0, 36, 73,109, 146, 182, 219, 255.
2. Analog Signal Levels: For analog signals, if Vw is the white level and Vb is the black level, then for m levels the signal step size is ΔV = (Vw - Vb)/m and Vj= Vb + jΔV.

# Dataset Management

This clause covers dataset management on the ECDIS to the extent that it affects the user experience and portrayal processing.

## Multiple product versions and portrayal

The ECDIS must be able to carry and use multiple versions of the Feature Catalogue for a product. Catalogue management is based on the version number of the Product Specification and Catalogues. For example, the ECDIS will need to carry all valid Catalogues that are used for datasets that have been produced from an earlier edition of a Product Specification; but may retire a superseded version after the last such dataset has been cancelled.

See Appendix C-2 for loading and ingest processes including SSE Codes relating to Product Specification and Interoperability Catalogues.

IHO Publication S-97 recommends that the versioning of Product Specifications follow the same rules as S-100, which uses a three-part version number (*Edition.Revision.Clarification*). The significance of each component is summarised below.

* Edition: New Editions introduce significant changes, such as the ability to support new functions or applications; or the introduction of new constructs or data types. New Editions are indicated by incrementing the *Edition* component of the version number and resetting the other components to 0.
* Revision: Revisions introduce substantive semantic changes. ~~Changes in a Revision ensure backward compatibility with previous versions within the same Edition. A Revision, for example, may introduce new features and attributes, but will not delete a feature or attribute~~. New Revisions are indicated by incrementing the *Revision* component of the version number and resetting the *Clarification* component to 0.
* Clarification: Clarifications are non-substantive changes. Typically, Clarifications remove ambiguity; correct grammatical and spelling errors; amend or update cross references; and/or insert improved graphics, spelling, punctuation and grammar. Clarifications must not cause any substantive semantic changes. Changes in a Clarification are minor and ensure backward compatibility with the previous versions within the same Edition. Clarifications are indicated by incrementing the Clarification component of the version number.

Each dataset has a product specification edition number contained within it.

[**add** **encoding specifics of how versions are identified in the datasets.**].

This requires the ECDIS to have installed a feature catalogue which has a matching edition and revision number. Multiple feature catalogues **must** therefore be supported to maintain different revisions of datasets within the System Database.

A feature catalogue is only compatible with portrayal catalogues having the same edition and revision number.

Further consequences for portrayal are:

1. It should be possible to process datasets conforming to an earlier Revision within the same Edition, with the Feature and Portrayal Catalogues for the latest Revision in that Edition.
2. It should be possible to process datasets conforming to an earlier Revision or Clarification within the same Edition with the Feature and Portrayal Catalogues for the latest.
3. A Portrayal Catalogue for a new Clarification can always rely on earlier versions of the Feature Catalogue within the same Edition. (Note that an old Feature Catalogue cannot be relied on for processing the dataset for a newer Revision. That is OldDataset+OldFC+NewPC is processable, but NewDataset+OldFC+NewPC is not.)
4. It should be possible to process datasets conforming to a Clarification with the Feature and Portrayal Catalogues for an earlier Clarification within the same Edition and Revision.
5. ~~The significance of changes to only a Portrayal Catalogue (without a concomitant change to the Product Specification or Feature Catalogue) can be more difficult to classify (as a New Edition, Revision, or Clarification), because in addition to data model semantics, human factors effects for user interfaces and IMO guidance about compatibility, text abbreviations, etc, must also be considered.~~

In general, the IHO and/or Type Approval Authority should be consulted to determine the significance of the change. This also applies to Revisions planned by Project Teams.

## Dataset overlaps and gaps

### Overlaps and gaps in ENC coverage

There may be cases where ENCs in the same scale range overlap. Such may be the case at agreed adjoining producer data limits, where, if it is difficult to achieve a perfect join, an overlapping buffer zone of up to 5 metres may be used.

Where an overlap of more than 5 metres between two or more datasets exists the ECDIS **must** only display one dataset for the overlap area and provide a permanent and persisting indication “overlap”.

### Overlaps and gaps between other data products

Overlaps in datasets of the same scale range in products other than the ENC should be indicated by a non-permanent indication “Overlap in ??? data” (where ??? is the abbreviation for the data product). If interoperability has been activated, the Interoperability Catalogue may have a rule to break the tie, in which case an indication is not needed. An exception to this rule is S-102 and S-104 data used for Water Level Adjustment. In these cases, as with ENC overlaps, the ECDIS **must** only select and use a single dataset from the overlapping data available and provide a permanent and persisting indication “overlap” as per ENCs.

Coverage gaps in products other than the ENC can be expected and should not be indicated. Similarly, overlaps between different data producers’ ENC and other data products other than ENC should also be expected. Certain features, such as radio service areas can extend far beyond national boundaries and may therefore overlap other data producers’ ENC data. An indication is not needed in these cases.

## Guidance on updating S-100 datasets on ECDIS

### Introduction

In a previous Edition (3rd Edition, December 1996), S-52 Appendix I provided guidance for the updating service and the ECDIS to support the updating of ENCs issued through a Regional ENC Coordinating Centre (RENC). Following a HSSC-requested review by the ENC Updating Working Group (EUWG), guidance related to ENC updates production by HOs and their distribution was mainly integrated into Edition 2.0.0 of IHO publication S-65 *ENC Production, Maintenance and Distribution Guidance* and Edition 3.0.0 of IHO Publication S-57 Appendix B.1, Annex A *Use of the Object Catalogue for ENC*. Beginning with Edition 4.0.0 (April 2012), S-52 Appendix I was limited to describing guidance for the processing of automatic and manual ENC updates by ECDIS.

The current Editions of S-57 and S-65 continue to apply to the production and data delivery for S-57 ENC updates. S-52 Appendix I continues to apply to the processing of S-57 updates on ECDIS.

The guidance in S-52 Appendix I has been updated for S-100 datasets on ECDIS and is provided in clauses C-21.3.2–C-21.3.5 below. Except for C-21.3.5 (support file updates), which is a new requirement for support files, and the addition of language relating to authentication, the requirements are the same as S-52 Edition 6.1.1 with the language updated to include data products other than ENCs.

Some products may require or permit the use of data protection. Whether data protection has been applied to a dataset can be determined from the dataset discovery metadata in the exchange catalogue file (see S-100 Part 17). Digital signatures and authentication are described in S-100 Part 15. The protection method is indicated in dataset discovery metadata (S-100 Part 17; it should also be documented in individual Product Specifications. At present there is only one method specified in S-100, which is described in Part 15. S-100 Part 15 should be referenced for authentication and integrity checks).

### General requirements

1. **Data Integrity**. The ECDIS should be able to process updates to S-100 data products without degradation of the information content of the dataset or dataset update. For example, all information regarding attributes, logical relationships, geometry, and topology must be accounted for.
2. **Verification of Application**. The ECDIS should provide a method to ensure that updates have been correctly applied to the System Database (or other appropriate database for products held outside the System Database). Those updates are either an official data product update integrated into the display; an update to non-official products installed on the system; or temporary information that was entered manually.
3. **Integrated/Non-integrated Updates Distinction**. Updates should be clearly distinguishable on the display. Once accepted, integrated updates to ENCs should be indistinguishable from ENC data. Non-integrated updates (that is, those entered manually) must be distinguishable as described in clause C-12.11.1. Updates to non-ENC data must be treated as described in C-9.1.3 and C-12.11.4.
4. **Storage Separation**. ECDIS should store all updates separately from the original datasets. However, such separate storage may utilize the same data storage device.
5. **Recall for Display**. It should be possible on demand to review previously installed updates.
6. **Compatibility**. Updates to S-100 products must comply with the applicable Product Specification. Only ISO8211 and GML encoded data can support updates, as described in Part 10a and 10b respectively. The use of GML updates as described in Part 10b is used, in particular, by S-128 to update catalogue information used by the ECDIS to produce update Status Reports, as described in Appendix C-3 - ECDIS Update Status Reports.
7. **Non-interference**. ECDIS should be able to receive updates without interfering with its current operation.
8. **Log File**. ECDIS should keep a record of updates, including time of application and identification parameters described in the applicable Product Specification, through a log file. The log file should contain, for each update applied to or rejected by the System Database, the following information:

**.1** date and time of application/rejection;

**.2** complete and unique identification of update as described in the applicable Product Specification;

**.3** any anomalies encountered during application;

**.4** type of application: manual/automatic.

1. **Update out of sequence**. The ECDIS should warn the user when an update is applied out of sequence, terminate the update operation and restore the System Database as it was before the application of the update file.

NOTE (informative): Sequences are determined by the update and Edition numbers, not by issue date and time. However, sequential updates should have issue date/time combinations that are consistent with the sequence of updates as determined by the update and Edition numbers. Issue date/time are given in dataset discovery metadata in the Exchange Catalogue (see S-100 Part 17). Note that time is optional. Note also that it is possible for the date/time for two or more consecutive updates to be the same - in fact for data that are frequently updated, such as water levels, the date will be the same for many consecutive datasets.

### Automatic Update

1. **Interface**
   1. **Fully Automatic Updates**. The ECDIS should be capable of being interfaced to an appropriate telecommunication network.
   2. **Semi-automatic Updates**. The ECDIS should be capable of receiving official updates in standard IHO format by CD-ROM and from any other interface or data storage media that are provided with the ECDIS for that purpose and through telecommunication.
2. **Reception of Updates**
   1. Update data must be recorded automatically in the update storage of the ECDIS.
   2. The identification of the Issuing Authority of the update should be checked for conformance with the corresponding identifier of the dataset being updated.
   3. If any errors are detected from the receiving device, the reception procedure must be terminated and the update flagged invalid in the record of updates. The user should be informed of the corruption.
3. **Sequence Check**. The following sequence number checks should be performed at the time of application, for sequential and cumulative updates:

**.1** File extension of the update (if applicable);

**.2** Update number of the update;

**.3** Update sequence number of the individual records in the update. Refer to the relevant Product Specification for details on how the sequence numbers are encoded in the update.

1. **Authentication and Integrity Check**. If the Product Specification uses data protection and therefore requires the use of digital signatures, the ECDIS should authenticate updates using the applicable procedures. In some cases, updates that do not pass the authentication and integrity check should not be applied. The user should be informed of any authentication anomalies. Update authentication-related messages for the user may be combined or throttled to avoid flooding the user, but should all be logged in the log file (see appendix C-2).

**Data Integrity and Authentication Check**. All datasets require the use of digital signatures and the ECDIS should authenticate all updates using the applicable procedures. Updates that do not pass the authentication check should not be applied. The user should be informed of any authentication anomalies (refer to SSE codes). Update authentication-related messages for the user may be combined or throttled to avoid flooding the user, but should all be logged in the log file (see appendix C-2).

1. **Consistency Check**. The mariner should be warned of any previous updates which have not been successfully applied.
2. **Geographic Applicability**. Updates not relating to a dataset within the set of datasets in the ECDIS may be discarded.
3. **Summary Report**. A summary report for each of the Issuing Authority's official update files should be given after completion of receipt containing at least:

**.1** Identification of Issuing Authority;

**.2** Update numbers of the update files;

**.3** Dataset Identifiers of datasets affected;

**.4** Edition number and date of dataset involved;

**.5** Number of updates in the affected dataset.

1. **Review of ENC Updates**. It should be possible for the Mariner to review the updates applied through displaying the System Database contents with the updates highlighted.
2. **Modification of Updates**. Rejection or amendment of an update by the Mariner must be achieved by the manual update method. The questionable update should be noted as an anomaly in the Log File (see clause C-21.3.2(h)).
3. **Formatted Non-integrated Updates**, for example a temporary military exercise area, will be processed as manual updates.
4. **ECDIS Update Status Report.** It should be possible for the user to inspect and demonstrate the up to date status of all datasets held within the ECDIS against a complete list supplied by a service provider. Details of the required update status reports for both electronic chart and nautical publications datasets are given in Appendix C-3

### Manual Update

1. **Keying and Symbology**. The ECDIS should enable manual entry of updates for non-integrated presentation on the display. A capacity should exist to enable the mariner to:

**.1** Enter the update so it can be displayed as described in this Annex.

**.2** Ensure all update text information relevant to the new condition and to the source of the update, as entered by the Mariner, is recorded by the system for display on demand.

1. **Indications and Alerts**. The ECDIS should be capable of sensing indications and alerts related to non-integrated (manual) updates, just as it does for integrated updates.
2. **Presentation**. Manual updates must be displayed as described in this Annex, clause C-9.7.
3. **Text**. It should be possible to enter text into the ECDIS.
4. **Archiving of Manual Updates**. It should be possible to remove from the display any manual update. The removed update should be retained in the ECDIS for future review until commencement of the next voyage, but will not be otherwise displayed.

### Support file updates

When a feature pointing to a text, picture or application file is deleted or updated so that it no longer references the file, the ECDIS software should check to see whether any other feature references the same file, before that file is deleted.

## New editions, re-issues, cancellations and updates of datasets

The method for detecting whether a dataset is a New Edition, re-issue, cancellation, termination, or update is contained in the Exchange Set metadata field S100\_Purpose.

The behaviour of each is described below; note that individual Product Specifications may not implement all types of dataset state. All datasets include an issue date, and optionally an Edition and update number.

* New dataset – install new dataset and any included updates and record for tracking purposes.
* New Edition – replace numbered old Edition and its updates with the New Edition. The information in clause C-13.6 about the use of New Editions and re-issues for certain coverage data products should be kept in mind
* Update – apply the numbered update and retain for tracking purposes. See C-21.3. Where updates cannot be applied a permanent indication “Chart information not up to date” must be available in the chart display area when such a chart is in use (either displayed on chart area or used as largest scale available for chart related alerts and indications). This is also covered by the ECDIS Update Status Report, Appendix C-3.
* Re-issue - replace the original datasets and its updates up to the date of the issue with the reissued dataset. Retention of the old issue should be as specified in the Product Specification. The information in clause C-13.6 about the use of New Editions and re-issues for certain coverage data products should be kept in mind. After a re-issue, subsequent updates may be incorporated from this reissue or from the original data kept continuously updated.
* Cancellation – delete the cancelled dataset and its updates. The system must report any dataset(s) that have been identified as cancelled at load time. A message must be displayed informing the user of the dataset name. Depending on the method adopted by the OEM for managing cancelled datasets one of the following conditions must be observed: (1). The cancelled dataset cannot be viewed in the ECDIS; (2). The cancelled dataset can be viewed in the ECDIS with the warning message specified “Dataset <name> has been cancelled and may not be up to date. Under no circumstances should it be used for primary navigation”.

Keep in mind the guidance about updating support files (C-21.3.5) when replacing or deleting a dataset.

# Support File Formats

ECDIS support files must be limited to the following formats out of the support file formats listed in S-100 Part 17 S100\_SupportFileFormat enumeration:

* Plain text
* ~~HTML~~
* JPEG 2000
* TIFF 6.0

~~In addition, CSS (Cascading Style Sheets) files may be used for styling HTML and XML suport files. If used only in a single support file, the styles should be embedded rather than encoded in a separate CSS file. CSS files are encoded in discovery metadata as “other” support files.~~

All support files except the graphic formats must use UTF-8 encoding.

Specific restrictions on support files containing textual information are described in clause C-11.5. Specific restrictions on graphics files are described in clause C-11.6.

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# Appendix C-1 – Appendix C-1 Manual Editing and Update

# Introduction

* Manual updates are official data entered manually into the ENDS/ENC. Manually entered updates must be marked by specific symbols.
* Indications and alerts should be triggered as for all official ENC data.

In order to provide a harmonised and consistent approach to manual editing and update on the ECDIS a set of portrayal symbols is supplied alongside this publication. These symbols, contained within an S-100 portrayal catalogue and feature catalogue allow the OEM to implement a manual update and editing feature on the ECDIS.

A description of the supplied symbols is provided in this Appendix.

Need to include:

* Description of feature model.
* Brief Chart 1 style image of the symbols.
* Any guidance on how they should be used?
* Is there an alert/indication aspect of manual updates?

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# Appendix C-2 - S-100 Data Import Error Codes and Explanations

Loading, Updating, Authentication and Decryption error codes and messages are defined in this section. It is expected that application developers may also support the error conditions with an appropriate error message.

When an error occurs, this can in some instances, prevent further processing of data.

|  |  |
| --- | --- |
| **Error Code** | **Error Message** |
| **SSE 101** | *Self Signed Key is invalid* |
| **SSE 102** | *Format of Self Signed Key file is incorrect* |
| **SSE 103** | *Signed Data Server Certificate is invalid* |
| **SSE 104** | *Format of SA Signed DS Certificate is incorrect* |
| **SSE 105** | *SA Digital Certificate (X509) file is not available. A valid certificate can be obtained from the IHO website or your data supplier* |
| **SSE 106** | *The SA Signed Data Server Certificate is invalid. The SA may have issued a new public key or the dataset may originate from another service. A new SA public key can be obtained from the IHO website or from your data supplier* |
| **SSE 107** | *SA signed DS Certificate file is missing. A valid certificate can be obtained from the IHO website or your data supplier”* |
| **SSE 108** | *SA Digital Certificate (X509) file incorrect format. A valid certificate can be obtained from the IHO website or your data supplier* |
| **SSE 109** | *Dataset Resource Digital Signature is invalid* |
| **SSE 110** | *Dataset Permits not available for this Data Server. Contact your data supplier to obtain the correct permits.* |
| **SSE 111** | *Dataset Permit not found. Load the permit file provided by the data supplier.* |
| **~~SSE 112~~** | *~~Dataset Permit format is incorrect. Contact your data supplier and obtain a new permit file.~~* |
| **SSE 113** | *Dataset Permit is invalid (checksum is incorrect) or the Dataset Permit is for a different system”. Contact your data supplier and obtain a new or valid permit file.* |
| **SSE 114** | *Incorrect system date, check that the computer clock (if accessible) is set correctly or contact your system supplier.* |
| **SSE 115** | *Subscription service has expired. Please contact your data supplier to renew the subscription licence* |
| **~~SSE 116~~** | *~~ENC CRC value is incorrect. Contact your data supplier as ENC(s) may be corrupted or missing data.~~* |
| **SSE 117** | *User Permit is invalid (checksum is incorrect). Check that the correct hardware device (dongle) is connected or contact your system supplier to obtain a valid User Permit.* |
| **SSE 118** | *HW\_ID has incorrect format* |
| **~~SSE 19~~** | *~~Permits are not valid for this system. Contact your data supplier to obtain the correct permits~~* |
| **SSE 120** | *Subscription service will expire in less than 30 days. Please contact your data supplier to renew the subscription licence* |
| **SSE 121** | *Decryption failed no valid dataset permit found. Permits may be for another system or new permits may be required, please contact your supplier to obtain a new licence* |
| **SSE 122** | *One or more of the SA Digital Certificate or Domain Controller certificates (X509) have expired. A new SA public key can be obtained from the IHO website or from your data supplier* |
| **SSE 123** | *Non sequential update, previous update(s) missing try reloading from the base media. If the problem persists contact your data supplier* |
| **SSE 124** | *~~Dataset Signature format incorrect, contact your data supplier~~* |
| **SSE 125** | *The permit for dataset < name> has expired. This dataset may be out of date and MUST NOT be used for Primary NAVIGATION* |
| **SSE 126** | *This Dataset is not authenticated by the IHO acting as the Scheme Administrator* |
| **SSE 127** | *Dataset <dataset name> is not up to date. A New Edition, Re-issue or Update for this cell is missing and therefore MUST NOT be used for Primary NAVIGATION* |
|  |  |
|  | ***[Added for S-100 Support]*** |
| **SSE128** | *Error installing <file name>. The format or content could not be validated and it could not be installed* |
| **SSE129** | *This Catalogue is not authenticated by the IHO acting as the Scheme Administrator* |
| **SSE130** | *Warning: Dataset <dataset name> is not up to date. A New Edition or Update for this cell is missing* |
| **SSE131** | *Error: No Feature Catlaogue or Portrayal Catalogue could be found for dataset <dataset name>* |
|  |  |
| **SSE132** | *Signature Path can not be validated. One or more of the Domain Controller or SA digital certificates is missing or invalid* |
| **SSE133** | *Version mismatch between <dataset> and <catalogue>. Only <catalogue version> is supported for data of this type (<product>)* |
| **SSE134** | *This Exchange Set is not authenticated by the IHO acting as the Scheme Administrator* |
| **SSE135** | *This Permit file is not authenticated by the IHO acting as the Scheme Administrator* |

Table C-2-1 - Error codes and messages

**SSE 101** must be returned when a self signed key (SSK) cannot be validated against the public stored as part of the SSK. The data server must check that its own SSK is valid before sending it to the SA. The SA will confirm the data server SSK before returning the SA signed data server certificate.

**SSE 102** must be returned if the SSK is wrongly formatted or if mandatory elements are missing. SA and data servers must complete this check.

**SSE 103** must be returned if the Signed data server certificate does not authenticate correctly against the SA public key or any Domain Controller Intermediaries. This validation process must be carried out by the SA or Domain Controller before supplying it to the data server. The data server must also validate a received certificate. The data client must validate the digital signature against any file prior to its use.

**SSE 104** must be returned if the SA signed data server certificate is wrongly formatted. This must be carried out by the data server on receipt from the SA.

**SSE 105** must be returned if there is no SA certificate installed on the data client.

**SSE 106** must be returned if the SA digital certificate (public key) does not validate against the following:

* SA digital certificate will not validate against the SA public key.
* One or more of the Domain Controller certificates do not validate against the SA certificate.

**SSE 107** must be returned if the SA signed data server certificate is not available to the data server for checking or is not present in the Exchange Set Catalogue file when the data client attempts to authenticate it.

**SSE 108** must be returned if the SA public key held in the SA digital certificate is wrongly formatted or the certificate file is unreadable.

**SSE 109** must be returned if any resources (dataset or supplementary file) in the Exchange Set Catalogue do not authenticate against the SA authenticated data server public key or Domain Controller authenticated public key contained in the Exchange Set Catalogue metadata.

**SSE 110** must be returned if there are no dataset permits available for a particular data server corresponding to encrypted data within the Exchange Set being loaded.

**SSE 111** must be returned if there are no permits installed on the system for a required dataset.

**~~SSE 112~~** ~~must be returned if the dataset permits are formatted incorrectly.~~

**SSE 113** must be returned if the calculated CRC of an individual dataset permit does not validate against the CRC held in that cell permit. [Data Clients] This may be a HW\_ID problem, corruption during transmission or the permits are for a different system.

**SSE 114** must be returned if the system date does not agree with the date obtained from any alternative, reliable date source; for example, GPS. [Data Clients]

**SSE 115** must be returned if the expiry date of the dataset permit has an earlier date than that obtained from the validated system date. [Data Clients]

**~~SSE 116~~** ~~must be returned if the calculated CRC value of the ENC (after decryption and uncompressing) does not validate against the corresponding CRC value in the CATALOG.031 file. This also applies to the unencrypted signature, text and picture files. [Data Clients] NO CRCs]~~

**SSE 117** must be returned if the CRC contained in the User Permit does not validate against the calculated CRC of the extracted HW\_ID. [Data Servers]

**SSE 118** must be returned if the if the decrypted HW\_ID extracted from the User Permit is incorrectly formatted. [Data servers]

**~~SSE 119~~** ~~must be returned if the HW\_ID stored within the hardware/software security device cannot decrypt the cell permits being loaded or already installed on the system. [not used anymore]~~

**SSE 120** must be returned if the subscription licence is due to expire within 30 days or less.

**SSE 121** must be returned if a valid dataset key (decryption key) cannot be obtained from the relevant dataset permit to enable the system to decrypt the corresponding dataset.

**SSE 122** must be returned if the SA Digital Certificate or any of the intermediate Domain Controller Certificates have expired. Expired is when the X.509 ***“Valid to”*** date in the certificate is older than the validated system date.

**SSE 123** must be returned if a dataset update being imported is not sequential with the latest update already contained in the ENDS/System Database for any given dataset. Under these conditions the update process (for the dataset) must be terminated and the ECDIS is to display a warning when the dataset is displayed stating that it is not up to date and should not be used for navigation.

**SSE 125** must be returned if the stored permit for any given dataset has expired. It should be possible to view the dataset but a permanent warning message must be displayed informing the user; for example, *“The permit for dataset <name> has expired. This dataset may be out of date and MUST NOT be used for Primary NAVIGATION”.*

**SSE 126** must be returned if a signed resource (dataset, catalogue or permit) in an Exchange Set is authenticated against a certificate or public key file stored on the Data Client other than the one provided by the SA. In a chain of digital signatures the root certificate must be the SA certificate.

**SSE 127** must be returned if the status of the dataset being viewed is not up-to-date in respect of the latest installed S-128 Catalogue dataset loaded or maintained on the system. A permanent warning message must be displayed on screen informing the user; for example, *“dataset <cell name> is not up to date. A New Edition, Re-issue or Update for this dataset is missing and therefore MUST NOT be used for Primary NAVIGATION”.*

**SSE 128** must be returned if one or more dataset resources (datasets, catalogues or permits) could not be loaded because the contents could not be validated according to the versions of the (XML) Schemas installed on the system. Only conformant content may be loaded onto any S-100 system.

**SSE 129** must be returned if the Catalogue to be installed (Feature, Portrayal or Interoperability) has not been directly authenticated by the Scheme Adminstrator.

**~~SSE 130~~** ~~must be returned if the status of one or more non-ENC datasets or supplementary files being viewed is not up-to-date in respect of the latest installed S-128 catalogue dataset loaded or maintained on the system. A warning message must be displayed on screen informing the user, e.g.~~ *~~“Warning: dataset <dataset name> is not up to date. A New Edition or Update for this dataset is missing”.~~*

**SSE 131** must be returned if a dataset has no Feature Catalogue or Portrayal Catalogue installed.

**SSE 132** must be returned if an intermediate digitalSignatureValue for a resource (whether dataset, supplementary file or permit) fails validation.

**SSE 133** must be returned if the dataset being installed is of a version which is not identical to a Feature Catalogue or Portrayal Catalogue installed on the system.

**SSE 134** must be returned if the CATALOG.XML digital signature (CATALOG.SIG) cannot be authenticated against the Scheme Adminstrator’s certificate, either through the data server’s signed public key or any specified intermediate Domain Controllers. The contents of the Catalogue must not be installed if the signature is invalid.

**SSE 135** must be returned if the PERMIT.XML digital signature (PERMIT.SIG) cannot be authenticated against the Scheme Adminstrator’s certificate, either through the data server’s signed public key or any intermediate Domain Controllers.

The flow diagrams in this Appendix show the conditions under which the SSE codes are displayed. These diagrams only relate to processes carried out on the ECDIS for import of exchange set contents. Data Server and Scheme Administrator processes are not defined here.

**Exchange Set Installation on ECDIS.**

The following Figure shows the sequence of actions to import Exchange Set contents. These contents are all digitally signed, and may optionally be encrypted.

For encrypted data the following process is first used to establish the validity of the permit.xml and its contents in respect of the end user’s subscription details. This is only for use with datasets which are encrypted and should be carried out prior to dataset file decryption according to S-100 Part 15.

A picture containing timeline

Description automatically generated

Figure C-2-10 - Check for permit validity prior to decryption

Once encryption and compression has been processed the digital signatures for all Exchange Set contents to be imported can be processed. These signatures can form a chain of authentication and the following flow Figure illustrates how such signatures should be processed.



Figure C-2-2 - Authentication of Exchange Set CATALOG.XML, permits and dataset components

Under S-100 Part 15 datasets and other Exchange Set components can have multiple digital signatures, with each signature referenced to a signed public key certificate. The Exchange Set contains all relevant certificates with the exception of the SA digital certificate which is installed separately by the end user.

Using the flow shown in Figure C-2-2 the chain of certificates for dataset components, permits and the catalog.xml itself can be authenticated.

Full documentation of the authentication processes and technical details are contained in S-100 Part 15.

Certain Exchange Set contents control the behaviour of the ECDIS and may only be digitally signed by the Scheme Administrator. These categories of content, the Feature Catalogues, Portrayal Catalogues and Interoperability Catalogues should be authenticated using the following process. IHO standards determine the content and revision of such Catalogues.



Figure C-2-3 - Authentication of Feature, Portrayal and Interoperability Catalogues

# Appendix C-3 - ECDIS Update Status Reports

**Purpose**

This Appendix elaborates the definition of an “up to date” dataset. This is required by the IMO Performance Standards and all ECDIS users are required to be able to demonstrate to a vetting inspector that their ECDIS and its installed datasets are “up to date”.

This Appendix specifies the format and content of an “Update Status Report” which will demonstrate the revision status of datasets within the ENDS/System Database of the ECDIS. There are two Update Status Reports required:

1. An ENC Update Status Report, which reports the contents of electronic charts and directly related information.
2. An ENP (Electronic Nautical Publication) Update Status Report which reports the status of ENPs

**Use and Responsibility**

An Update Status Report is designed as a concise and standardised format to assist end users in satisfying themselves that their data is “up to date” and help satisfy inspection requirements in that respect.

The report is designed for two individual use cases:

1. To ensure that all navigational data loaded into the System Database is up to date for a section of a particular route
2. To ensure that all navigational data loaded into the System Database is up to date.

All S-100 datasets use Edition and, sometimes, update numbers to denote their individual revision (see S-100 Part 17 for details). These numbers uniquely identify how up to date a dataset is. The difficulty with using Edition/update numbers in isolation is that they do not document the date of revision of all datasets relative to the installation date of a data server’s service giving the end user no indication of whether a dataset (or a collection of datasets) is up to date with respect to the last dataset installed.

S-100 supports the creation and distribution of IHO S-128 data which provides an issue date within its metadata for an entire data service as well as a snapshot of the Edition and update information for all component datasets within a data service. The issue date of the last delivered S-128 dataset is used in each update status reports to provide a reference date for every dataset either on a section of the vessel’s route or for the System Database as a whole.

The driving use case for the Update status report is that an inspector (for example flag State, port State or vetting) or end user can check that an ECDIS is up to date with respect to the last dataset installed from each data server’s data within the System Database.

Note that this report specification is not a concrete definition of what an “up to date” dataset (or ECDIS) is; it only shows a status of each dataset with respect to the last data installed on the system. If a period of time has passed since the last update then some data may well be “out of date” relative to the time the report is run – the report only records the up to date status relative to the last data installed (the date being defined by the issue date of the latest S-128 dataset). The equipment manual should explain terms “up to date” and “out of date”.

This report only reports the status of datasets delivered as part of a data service using S-100 Part 17 Exchange Set metadata and (as part of dual-fuel mode) IHO S-57 datasets (as illustrated in the hybrid Exchange Set in S-100 Part 17, clause 17-4.2). Where other S-100 datasets are installed on the system from other sources (for example, Unencrypted ENCs) then they should be displayed with a status of “unknown”. The Equipment manual should explain terms “unknown”.

This Appendix provides a specification for a report which can be run on a compliant ECDIS to determine the status of S-100 datasets held within the System Database.

**Report Definitions**

**Report Contents**

Two reports are required:

1. An ENC Update Status Report, which reports the contents of electronic charts and directly related information. This report shows the status of IHO S-100 datasets of the following product types:
   1. ENC, either S-101 or S-57
   2. S-102
   3. S-104
2. An ENP (Electronic Nautical Publication) Update Status Report which reports the status of ENPs. All other S-100 products (with the exception of S-128 itself) installed in the System Database are in this category.

The report name at the top of the report header shows the type of Report being produced.

**Report Filters**

The Update status report defined in can take one of two forms:

1. A report detailing the status of all datasets within the System Database of the ECDIS for the appropriate type (ENC or ENP). This shows the status of the datasets with respect to the date contained in the S-128 dataset of the last update for each data server’s service installed.
2. A report detailing the status of each S-100 dataset along a predefined section of a route contained within the ECDIS.

**Example**

An example of an Update Status Report for current ECDIS with S-57 ENCs is shown in the Figure C-3-1, followed by an illustrative revised report for S-100 datasets in Figure C-3-2. The example shown is an ENC Update Status Report.



Figure C-3-1 - Update Status Report – current report example



Figure C-3-2 - Update Status Report - notional example for S-100 datasets

**Report specification**

The ENC Update Status Report is a formatted output from the ECDIS. It should be formatted to fit within the width of the ECDIS screen and, if printable, split into individual A4 pages.

Reports of both types (complete System Database contents and filtered by route) are divided into two sections:

1. A header containing information on the vessel and report content selected (either filtered for a route (or part of a route) or for the entire System Database contents. This header contains vessel information and report reference dates followed by a summary totals for each report status.
2. A table containing information for each cell within the chosen content type. This provides detailed information on each dataset within the chosen content category.

**Report header**

The data content of each of the header fields is defined in Table C-3-1 below:

|  |  |  |
| --- | --- | --- |
| **Field Name.** | **Type** | **Source** |
| 1. Report Name | Text | Two Report names are possible depending on which Report is being shown. Either:   * Electronic Navigational Charts (ENC) Update Status Report * Electronic Nautical Publications (ENP) Update Status Report |
| 1. Vessel Name | Text | The name of the vessel as recorded within the ECDIS. |
| 1. Identifier | Text | A unique identifier, the MMSI or vessel IMO number. |
| 1. Update reference date | Date | The data used as the reference for the status of each of the cells. This is the issue date of the last S-128 dataset in the Exchange Set used to update the System Database. The date is taken from the latest S-128 datasets issueDate in the CATALOG.XML and is expressed in ISO8601 notation:  [**YYYMMDDZHHMMSS**] |
| 1. Date of report | Date | The date the Report was run. |
| 1. Content | Text | Each Report can be optionally filtered for an individual route plan or report the full System Database contents for each Report type:   * “Filtered for Route Plan XXX to YYY” where XXX and YYY are the textual names of the point of origin and destination on the chosen route. * Full System Database contents. |
| 1. Start WP | Text | This field is only present if the Report is filtered for a route. It should comprise the textual name of the starting waypoint of the route (if one exists) and the lat/long coordinates of the waypoint. There is no fixed form that the coordinates should take. |
| 1. End WP | Text | This field is only present if the Report is filtered for a route. It should comprise the textual name of the last waypoint of the route (if one exists) and its lat/long coordinates. There is no fixed form that the coordinates should take. |

Table C-3-1 - Data content of header fields

**Filtering of Update status report for route section**

Where an Update Status Report is filtered for a route plan then the datasets of the appropriate type (ENC or ENP) in the System Database whose status are checked are defined by the intersection of the route corridor with the dataset boundaries (as defined by dataset’s coverage features (or coverage defined in the S-100 CATALOG.XML within the System Database)).

The width of the filtering corridor is equal to the “user specified distance” implemented inside the ECDIS to fulfil IMO MSC.532(106) *11.3.5:*

*“A graphical indication should be given if the mariner plans a route closer than a user-specified distance from the boundary of a* user-selectable category of *prohibited area or a geographic area for which special conditions exist (see appendix 4). A graphical indication should also be given if the mariner plans a route closer than a user specified distance from a user-selectable category of point objects, such as a fixed or floating aid to navigation or isolated danger*. *The user-selectable categories should be the same as the user selections for the display of objects and be based on IHO standards. There should be a permanent indication when any user-selectable categories are deselected. Details of the deselection should be available on demand*.“

This is not the same as the XTD distance.

**Summary totals**

The summary section of the Report follows directly after the header. The summary contains the following information:

1. The title: “Chart Status Summary”.
2. Totals of cells with the relevant status in the order defined below.
   1. Total – the total number of datasets available in the System Database for the content type (ENC or ENP), selected for the Report (either full or filtered by route).
   2. Up to date – the total number of datasets (for the content selected) which have status “Up to date”.
   3. Not up to date – the total number of datasets (for the content selected) which have status “Not up to date”.
   4. Withdrawn – the total number of datasets (for the content selected) which have status “Withdrawn”.
   5. Cancelled – the total number of datasets (for the content selected) which have status “Cancelled”.
   6. Unknown – the number of datasets for which a status cannot be determined for any reason.
3. The possibilities for each dataset’s status are listed in Table C-3-2 below along with their definitions.

**Data Server content tables**

The detailed tables in each Report are arranged by data server – each separate data server or dataset data source within the System Database has its own separate table listing all datasets by content type (as reported in the “Content” field in the report header) and S-100 Product Specification order.

The detailed tables contain the following information:

1. Title: Data Server Name – this is the data server identified by the S-128 Producer attribute.
2. For each cell installed in the System Database from the data server:
   1. Dataset Name – the name of the dataset. (DSNM).
   2. Edition – the Edition of the dataset in the System Database (EDTN).
   3. Update – the update number of the dataset in the System Database. If the product does not support updates, then this must be labelled “-“.
   4. Issue Date – the issue date of the last applied update to the dataset in the System Database (or “-“ where no updates are supported for the S-100 product).
   5. Status – the status of the cell. The status may have one of four values determined according to the criteria in the following table:

|  |  |
| --- | --- |
| **Status** | **Specification** |
| **Up to date** | This is where the System Database has all the latest Edition and (where supported by the S-100 Product Specification) update information for the dataset installed as defined by the latest S-128 dataset received from the data server.  The reference date for the most up to date information is defined by the S-128 dataset issue date. The dataset update reference date must be within the last four weeks from the time of the Report execution or the cell must be displayed as “Not up to date” regardless of its status as defined by the S-128 data. |
| **Not Up to date** | This is where the System Database has NOT installed all the latest update and/or New Edition for the cell. Again, the reference point for what should be installed is defined by the S-128 dataset issue date. If the reference date is older than four weeks then cells must be displayed as “not up to date” by definition. |
| **Withdrawn** | The number of datasets which have been withdrawn by the data server or cancelled but which are still available within the System Database. |
| **Unknown** | Datasets for which a status cannot be determined for any reason. If the revision information in the latest S-128 dataset is incomplete for any reason then all datasets in the data server’s service not included in the partial S-128 must be deemed to be “Unknown” as no definitive information on them can be determined. S-128 content is required to specify the status of all datasets in a data server’s service. |

Table C-3-2 - Status values

**Example of ENC update status report**

***Report Name: ENC Update Status Report***

**Vessel Name:** HMS Goteborg

**Identifier:** IMO 4653321

**Update Reference Date:** 16 May 2013

**Date of Report**: 1 Jun 2013

**Content:** Full

**Chart Status Summary:**

**Chart Status: Count**

Total: 50

Up to Date 38/50

Not Up to Date 10/50

Withdrawn 2/50

Unknown 0/50

***Table:***

**Data Server: XXXX**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Product** | **Dataset Name** | **Edition** | **Update** | **Issue Date** | **Status** |
| **S-101** | **101US23495820** | **10** | **4** | **2020-01-02** | **Up to Date** |

**Example of ENP update status report**

***Report Name: Electronic Nautical Publications (ENP) Update Status Report***

**Vessel Name:** HMS Goteborg

**Identifier:** IMO 4653321

**Update Reference Date:** 16 May 2013

**Date of Report**: 1 Jun 2013

**Content:** Full

**Chart Status Summary:**

**Chart Status: Count**

Total: 50

Up to Date 38/50

Not Up to Date 10/50

Withdrawn 2/50

Unknown 0/50

***Table:***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Server: XXXX** | | | | | |
| **Product** | **Dataset Name** | **Edition** | **Update** | **Issue Date** | **Status** |
| **S-123** | **123US3245394** | **5** |  | **2020-01-02** | **Up to Date** |
| **S-127** | **127US2345032** | **6** |  |  |  |

# Appendix C-4 - User Selected Safety Contour and Water Level Adjustment

# User Selectable Safety Contour

## Introduction

This Appendix defines how the “**User Selectable Safety Contour**” feature is defined and implemented.

User selectable safety contour means creation of the safety contour from the bathymetric grid data based on the value set by the user.

NOTE: Also, in the case of S-101 or S-57 the user sets the value for the safety contour, but if the exact value is not found from the available depth information in S-101 or S-57 then the safety contour defaults to the next deepest which may be over 10 metres deeper than the value set by the user.

In these processes an end user selects:

1. Suppression of certain S-101 features by S-102.
2. A Safety Contour value of their choice.

When a user selects a safety contour value, outside areas of S-102 coverage the source for the displayed safety contour is the existing S-101 ENC (or S-57 ENC in dual-fuel mode).

When the safety contour has been generated from S-102 data then the area over which it is generated, that is the S-102 coverage area, must be surrounded by a boundary line using colour token DEPWL[[5]](#footnote-10) see Figure C-4-1.

Map

Description automatically generated with medium confidence

Figure C-4-1 - Boundary line of S-102 coverage

## Data Constraints

1. Coverage – S-102 data is not expected to overlap, but in case of overlap the ECDIS should indicate an overlap by the text “OVERLAP” and the user should have the ability to select which producer in the overlapped area has priority and will be selected for processing safety contour.
2. No complex interpolation is done between points in the S-102 grid. Nearest neighbour is used to define the depth in each S-102 point's neighbourhood (that is, the same depth everywhere within the grid square), regardless of any interpolationType defined for the S-102 dataset (S-100 Part 8, clause 8-7.1.4), as illustrated by the following Figure:

Shape

Description automatically generated with medium confidence

Figure C-4-2 - The extents of the S-102 points overlaid on the S-102 grid (grid spacing = ‘d’)



Figure C-4-3 - Extents of each S-102 points showing nearest neighbour interpolation (S-100 Part 8-7.1.4)

1. Only rectangular grids for S-102 are allowed. The method outlined may be extended to other grids; for example, triangular grids in the future.
2. User Selected Contour can only be processed in areas where the Sounding Datum of suppressed S-101 features is the same as the datum defined in the S-102 Coverage.

## Implementation

The user may select S-102 to be used as the source of the depth information.

When S-102 is selected for use, in areas where S-102 coverage exists, the S-102 suppresses the following S-101 depth features,

1. Depth Area
2. Dredged Area
3. Depth Contour

The process to construct the safety contour then consists of a selection of common edges from rectangular extents for each S-102 dataset point, as shown in Figure C-4-4.

Chart, scatter chart

Description automatically generated with medium confidence

Figure C-4-4 - Common edges from rectangular extents

Common edges are selected when the S-102 points on either side of them lie on either side of the boundary of the safety contour value. In Figure C-4-5 below 11.5 metres is the threshold value set by the user.

Edges on the boundary of the dataset, or which lie on an edge common with undefined S-102 values, are selected if the S-102 value is less than or equal to the safety contour value; for example, see Figure C-4-5:

|  |  |
| --- | --- |
| Chart  Description automatically generated | A screenshot of a computer  Description automatically generated with low confidence |

Figure C-4-5 - Edges from rectangular extents and at boundaries

The source of the displayed safety contour are the selected edges as defined. The areas of safe and unsafe water formed by the selected edges are used for processing of the safety contour related alarms under IMO MSC 530(106) 11.4.3, which the OEM must implement.

# Water Level Adjustment

**[from C2]**

It must be possible to adjust depth information by water level height When water level adjustment is provided:

1. The system must default to no water level adjustment [what does “default” mean].
2. The mariner must be able to select one for the following methods of depth adjustment:
3. Current date and time;
4. A mariner specified date and time;
5. Where the ECDIS supports schedules, the depth at the predicted date and time of transit in each area along a route
6. When water level adjustment is applied as defined in this Section:
7. The safety contour, depth zone shades, safety depth and indication of isolated dangers must use the adjusted depth;
8. The pick report must indicate both adjusted and unadjusted depth;
9. The applied water level adjustment method must be provided in the legend;
10. Other details of the water level adjustment must be readily available, such as the data source, temporal extent, and applicable areas;
11. It must be possible to remove all water level adjustment via simple operator action;
12. There must be a permanent indication “Water level adjustment”.
13. ECDIS voyage recording must include:
14. The state of water level adjustment (method applied);
15. All other information necessary to reconstruct depths as presented to the mariner.

## General

This section defines how the adjustment of depth information by water level is provided for:

* Selected single date and time;
* Selected date and time period;
* Linked to an estimated route schedule with selected check distance and time resolution.

## Constraints on input data

1. Coverage – S-104 data is not expected to overlap, but in case of an overlap of greater than 5 metres the approach must be same as for overlapping S-102 data. The ECDIS must indicate an overlap by the text “OVERLAP” and the user **must** have the ability to select which producer in the overlapped area has priority and will be selected for processing WLA.
2. As with S-102, each S-104 point is assigned a rectangular extent and no complex interpolation is done between the points in the S-104 grid.
3. For WLA processing all S-102 and S-104 data must be on the same vertical datum.

## User inputs

The User may select WLA to be used as source of the depth information.

When WLA is selected for use, in areas where WLA coverage exists, the user selects one of three different WLA options:

1. WLA Option 1: WLA at a single datetime.
2. WLA Option 2: WLA for a single datetime period (from start datetime to end datetime).
3. WLA Option 3: WLA linked to an estimated route schedule. In this case the user also specifies:
   1. A distance parameter, the limit of the check area as specified by IMO MSC 530(106) 11.3.5.
   2. A time resolution tu used to construct the individual WLA sections. This time resolution reflects the uncertainty or tolerance of the time schedule of the route, for example 10 minutes if the user assumes that they could follow the time schedule within 10 minutes.

## Implementation - general

WLA can be applied only in areas where there is data from both S-102 and S-104. for example, the intersection of the Red and Blue outline in figure C-4-6 below. WLA is applied to S-101 features after substitution of depths by S-102 defined in clauses C-4-1 and section C-4-3.1.

Shape, rectangle

Description automatically generated

Figure C-4-6 - WLA can only be computed in areas where there is S-104 and S-102 data

Further WLA can only be carried out:

1. When WLA option 1 or WLA option 2 is selected, where the temporal extent of the S-104 overlaps the required datetime instant or period selected by the user
2. When WLA option 3 is selected, where the S-104 temporal extent of the S-104 overlaps the estimated time a part of the route; see figure C-4-16.

Where these conditions are not met the WLA processing is not carried out.

When WLA has been processed the area for which it is defined must be surrounded by a boundary line using colour token DEPWL[[6]](#footnote-11)); see Figure C-4-7.

Diagram, map

Description automatically generated

Figure C-4-7 - Boundary line of WLA coverage

NOTE: In this example S-102 coverage is larger than WLA coverage.

In addition to the display of the boundary line of the WLA coverage there should be a permanent indication about application of WLA and the applied datetime, see details in WLA Options 1, 2 and 3.

OEMs are free to design their user interface. Usable ideas include for example mouse roller to change datetime, use of a slider to change datetime, or even to provide an animation from user selected start datetime to user selected end datetime.

## Implementation of WLA Option 1 – WLA for a single datetime instant

WLA is based on S-104 values closest to the selected datetime instant. Each S-102 point has an extent of coverage which is closest to it. Each S-104 point, similarly has an extent. The adjustment of the S-102 values is calculated by adjusting each S-102 point by the shoalest of the S-104 values, for all S-104 points whose extent intersects the extent of the S-102 point.

When an S-104 record does not exist for the precise time specified the shoalest of the two S-104 adjacent values is selected from the S-104 dataset. S-104 values can only be selected within the temporal extent of the S-104 dataset. In the example shown in Figure C-4-8 below (S-104 values, “V” defined every 15 minutes and a user selected datetime of 07:24) the two values selected are 07:00 and 07:30, WLA would select 1.3m (the 07:00 value).

Chart, box and whisker chart

Description automatically generated

Figure C-4-8 - Selection of time-varying value

In Figure C-4-9 below, the S-102 point X is adjusted by the shoalest (that is, minimum) value of the S-104 values from (a), (b), (c) and (d) at the required datetime instant because the S-102 point extent overlaps the S-104 extents of a,b,c and d.

A screenshot of a video game

Description automatically generated with medium confidence

Figure C-4-9 - Adjustment of S-102 values by S-104

Format of the permanent indication is as below:

**WLA 12:34 08 Nov 2021**

## Implementation of WLA Option 2 – WLA for a datetime range specified by the user as a time period

When WLA is based on a datetime range, then the process is identical to that followed for WLA Option 1 except each S-104 value selected is the shoalest of all values available in the S-104 within the selected time period.

All S-104 points contributing to the WLA must be defined across the time range required, otherwise the WLA is not computable and the user must be informed. The S-104 records selected are those which lie either within the user defined time period; or before the start point of the time period and just after the end point of the time period. In the following examples:

A picture containing text, red, light, black

Description automatically generated

Figure C-4-10 - Examples of S-104 data selection

1. User selected period 1, four values are from 0700, 0730, 0800 and 0830 - WLA would select 08:30 value = 1.2m (even though the time period doesn't overlap).
2. User selected period 2, two values are from 0630 and 0700 - WLA would select 06:30 value V=1.2m (even though the time period doesn't overlap).
3. User selected period 3, three values are from 0600, 0630 and 0700 - WLA would select 06:00 V=1.1m (even though the time period doesn't overlap).
4. User selected period 4, five values are from 0630, 0700, 0730, 0800 and 0830 – WLA would select 07:30 V=1.2m.

When adjusting depth values the shoalest (smallest) value from the selected S-104 records must be used in order to produce the safest WLA values.

Format of the permanent indication is as below:

**WLA from 12:34 08 Nov 2021 to 14:56 08 Nov 2021**

## Implementation of WLA Option 3 – linking of WLA to a defined route with planned waypoints and times

When WLA is based on a route then the limit of check area around the route is set by the user as specified by IMO MSC 530(106) 11.3.5.

*The same user-specified distance shall be used for the check of safety contour, prohibited areas, geographic areas for which special conditions exist and navigational hazards” and equivalent requirements when route monitoring*

The WLA is processed within this check area. The boundary of the area of the display where WLA has been carried out must be displayed. In the process description this distance is referred to as ‘a’.

A route could be either a Planned route or a Monitored route. Both could be processed for the WLA, but not at the same time in a single display area. In case of multiple display areas, it is possible that one area is WLA processed for Planned route and another area is WLA processed for the Monitored route.

For a Planned route the datetime period applied for the WLA process is based on the schedule of the planned route itself.

For a Monitored route the datetime period applied for the WLA process is user selectable either:

1. Based on the planned schedule of the monitored route itself; or
2. Based on the monitored route adjusted for the current own ship position.

When WLA is based on the planned schedule and own ship is not keeping to schedule a Caution must be raised to indicate the water level being experienced may be different to that being applied by the ECDIS

The region of WLA is restricted to a distinguishable bordered polygon around the route. The process works as follows:

1. For each section of the route a series of estimated time markers is defined along the route at times t0 – tn. The diagram also shows the “limit of check area” as specified by IMO MSC 530(106) 11.3.5. Each time marker is delimited before and after by the time +/- half the user selected tu interval so the rectangle in the diagram represents the extent of time t1 which ranges from time to . This is the WLA adjustment polygon corresponding to time t1:

A picture containing dark, outdoor object, night sky

Description automatically generated

Figure C-4-11 - WLA adjustment polygon

1. Where the route follows a curved section the polygon formed is not a rectangle but an area defined by the user selected limit as shown by areas a and b:

Chart, radar chart

Description automatically generated

Figure C-4-12 - WLA adjustment polygon along curved section

1. The individual S-102 points (blue dots in Figure C-4-13 below) are assigned rectangular extents. For each WLA adjustment rectangle corresponding to each ti the S-102 extents which spatially intersect are selected. A full example is shown in Figure C-4-13 for one of the WLA polygons.

A picture containing light

Description automatically generated

Figure C-4-13 - Grid cell selection

1. For each S-102 point whose extent intersects the WLA adjustment box the Water level is adjusted using a similar process to Option 1. The S-104 value used for adjustment is the shoalest value from each of the S-104 points whose extents intersect the S-102 point (as described in WLA Option 1) across the time period () and (), In Figure C-4-14, illustrating this step, two S-102 points are adjusted by S-104 values in the time period () and (), for calculation of t1. S-102 point is adjusted using values drawn from S-104 points a and b (because its extent intersects the extents of a and b) and S-102 point y is only adjusted with values from S-104 point b.

A picture containing light, wire

Description automatically generated

Figure C-4-14 - Selection of S-104 data

1. Each of the S-102 points are assigned the adjusted water level equal to the S-102 value + the calculated (shoalest) S-104 value as defined in the previous step.
2. Once the WLA polygon for time ti is processed the WLA polygon for time ti+1 is processed.
3. S-102 points whose extents are intersected by the both the WLA polygon for ti and ti+1 are assigned the shoaler of the two values, that is the shoalest of the S-104 values between the two time periods () and (), and () and ().

This completes the WLA process for polygon ti ­. In Figure C-4-15 below the orange border shows S-102 points lying in WLA rectangles t1 and t2 and which would be assigned the shoaler of the two S-104 values corresponding to the t1 and t2 WLA process.

A picture containing indoor, light, black

Description automatically generated

Figure C-4-15: Time-dependent adjustment of S-102 data with S-104 data

This process is extended to all ti along the planned route.

Figure C-4-16 below shows a border line around all the WLA processed S-102 grid cells. This border marks the boundary of the Water Level Adjustment area and requires portrayal to inform the user which areas of the display are subject to WLA. This area is surrounded by a distinguishable boundary line using colour token DEPWL[[7]](#footnote-12)).

A picture containing background pattern

Description automatically generated

Figure C-4-16 - Boundary of adjusted area

Figure C-4-17 below shows how the rectangle is positioned in the middle of S-104 coverage area and at the edge of the S-104 coverage are.

Chart

Description automatically generated

Figure C-4-17 - Positioning in interior and at edge

Format of the permanent indication is as below:

**WLA from 12:34 08 Nov 2021 to 14:56 08 Nov 2021**

# Treatment of depth and water level related S-101 features

## Substitution and adjustment of depth values

### General

In areas covered by only S-102, all depth values are substituted for all ENC features at all scales which have depth attribution (that is, the attribute *valueOfSounding* bound to them in the S-101 Feature Catalogue)

In areas where WLA is processed, all depth values are adjusted for all ENC features at all scales which have depth attribution (that is, the attribute *valueOfSounding* bound to them in the S-101 Feature Catalogue).

### Areas covered by S-102 only or by both S-102 and S-104

Adjustment of different geographic primitives.

1. Point Features
   * For Areas covered by S-102 only, a value for the attribute *valueOfSounding* must be taken from the S-102 grid cell extents which intersects the point feature.
   * For Areas covered by S-102 and S-104, the value for attribute *valueOfSounding* is taken from the S-102 grid cell extents which intersect the point feature. WLA is then applied to this value using S-104 records selected from the S-104 grid cell intersecting the point feature. The S-104 value selected is as defined in sections C-4-2.5, C-4-2.6 and C-4-2.7.
2. For Curve and Surface features
   * For Areas covered by S-102 only, the value for *valueOfSounding* must be the shoalest value of all S-102 grid cells whose extents intersect the feature’s geometry within the S-102 coverage available. If the curve or surface feature is not completely within the S-102 then the value defined is the shoalest resulting from the original feature value in S-101 attribute and the value selected from the intersecting S-102 grid cells.
   * For Areas covered by S-102 and S-104, the value for *valueOfSounding* is first selected, as the shoalest value of all S-102 grid cells whose extents intersect the feature’s geometry. WLA adjustment is then applied to this value by selecting the shoalest value from all intersecting S-104 grid cells. The value selected is as defined in clauses C-4-2.5, C-4-2.6 and C-4-2.7. If the curve or surface feature is not completely within the S-104 coverage then the adjusted value is the shoalest value resulting from the original feature value in S-101 attribute and the WLA adjusted value.

Diagram

Description automatically generated with low confidence

Figure C-4-18 - Substitution of sounding value from S-102

Chart, scatter chart

Description automatically generated

Figure C-4-19 - Substitution of *valueOfSounding* attribute in S-101 Obstruction from S-102 data

The S-101 features for which this depth substitution is required in S-102 coverage areas are listed,(items 1,2 and 3 are also used as sources for indications under IMO MSC 530(106) 11.4.6).

1. Underwater/Awash Rock
2. Wreck
3. Obstruction
4. Foul Ground
5. Marine Farm/Culture
6. Soundings (either individual soundings or those which are part of an array) substituting the S-102 grid cell whose extents intersect the sounding position for the defined ZCOO (ISO8211).

If the depth substituted S-101 feature is covered by S-104, then WLA is processed using same method as for the underlying depth area.

Depth values must also be substituted for the attribute *depthRangeMinimumValue* in other S-101 features. These are:

1. Gate
2. Berth
3. Dry Dock
4. Floating Dock
5. Dredged Area
6. Swept Area
7. Pipeline Submarine/On Land
8. Recommended Track
9. Fairway
10. Recommended Route Centreline
11. Two-Way Route Part
12. Deep Water Route Centreline
13. Deep Water Route Part

For all features with substituted (and possibly adjusted values), the ECDIS Pick Report shall indicate the substituted/adjusted value and its source. The format and portrayal of depths and drying heights (that is, number of decimals, etc) is unchanged.

For example, for S-102 only covered area:

**Value Of Sounding 12.3 m [S-102]**

When an S-101 attribute has been WLA adjusted the pick report shall indicate the WLA adjusted value, source and time/date. The format of time date is: hh:mm dd mmm yyyy.

For example, for both S-102 and S-104 covered area:

**Value Of Sounding 15.5m [WLA 12:34 08 Nov 2021]**

**Value Of Sounding 15.5m [WLA from 12:34 08 Nov 2021 to 14:56 08 Nov 2021]**

### C-4.3.[Deleted]

## Adjustment of heights and vertical clearance values

Any vertical measurement which is referenced to the same vertical datum as the S-104 data, either by the dataset metadata VDAT or **Vertical Datum** meta feature shall be adjusted using the intersecting S-104 grid cell water level value. This shall be applied on any features within the coverage of S-104. Where a feature is not completely within the S-104 coverage the adjusted value is the minimum value resulting from the original feature value in S-101 attribute and the WLA adjusted value. Adjustment is defined for the following S-101 features:

1. Building.
2. Span Fixed
3. Span Opening
4. Conveyer
5. Cable Overhead
6. Pipeline, Overhead
7. Tunnel
8. Wind Turbine
9. Gate
10. Crane
11. Light All Round; Light Sectored; Light Fog detector; Light Air Obstruction.

The simple attributes adjusted are *height* and *verticalClearanceValue*. When adjusting height or clearance values the largest value from the selected S-104 records shall be used in order to produce the safest values.

The user shall be given a permanent indication that the Water Level (S-104) values have adjusted attributes in the data display. Where values are not adjusted due to an incompatibility of vertical datums in the data, the user shall be given a similar permanent notification.

When either *height* or *verticalClearanceValue* in S-101 have been substituted or adjusted the ECDIS Pick Report shall indicate the substituted value, source and time/date. The format of the height or vertical clearance values (that is, number of decimals, etc) is unchanged.

For example:

**Vertical Clearance Value 5.3 m Mean Sea Level [WLA 12:34 08 Nov 2021]**

**Value Of Vertical Clearance 15.5m Mean Sea Level [WLA from 12:34 08 Nov 2021 to 14:56 08 Nov 2021]**

## Alerts and indication details

Substituted or adjusted values in ENCs at the largest scale shall be used as input to any alarm/indication processing. These may or may not be the same as the substituted values which are portrayed as shown in Figure C-4-20 below which shows an illustration of the graphical highlight (red boundary and red transparent fill) for the intersected safety contour.

*Diagram

Description automatically generated*

Figure C-4-20 - Graphical highlight for intersected safety contour

## Legend details

The legend shall additionally indicate the vertical datum of S-102 and S-104. If the vertical datums are the same then a single indication is enough to cover S-101, S-102 and S-104.

1. “Discrete interpolation” means no interpolation between data points. [↑](#footnote-ref-6)
2. Values are for hypothetical data and display, and the figures have been reduced for reproduction in this document. [↑](#footnote-ref-7)
3. CSS files use hex RGB to specify colours. Colour profile files in portrayal catalogues use CIE and decimal RGB. [↑](#footnote-ref-8)
4. For example, S-101 (ENC) requires the parameter “Safety Depth”, but S-123 (Marine Radio Services) does not encode any depth information and therefore cannot use “Safety Depth”, so it may not be listed in S-123 Portrayal Catalogues. [↑](#footnote-ref-9)
5. colour token DEPWL, xyL values are: DAY x= 0.15, y=0.15, L=30.0; DUSK x=0.15, y=0.15, L=7.5; NIGHT x=0.15, y=0.15, L=1.2 [↑](#footnote-ref-10)
6. Thick dark blue dash line, colour token DEPWL xyL values are: DAY x= 0.15, y=¬0.15, L=30.0; DUSK x=0.15, y=0.15, L=7.5; NIGHT x=0.15, y=0.15, L=1.2. [↑](#footnote-ref-11)
7. *thick dark blue dash dot line,* colour token DEPWL, xyL values are: DAY x= 0.15, y=¬0.15, L=30.0; DUSK x=0.15, y=0.15, L=7.5; NIGHT x=0.15, y=0.15, L=1.2 [↑](#footnote-ref-12)